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SCSI BUS ANALYZER

Model

U l t r a - 2 0 0 0
&
U l t r a - 2 0 0 0 / L i t e

USER' MANUAL

Revision 2.0

March 1997
(converted Nov.2002)

ANCOT Corporation
1024 Hamilton Ave
Menlo Park, California 94025
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SECTION 1

DESCRIPTION OF EQUIPMENT

1.1 INTRODUCTION

The Ultra-2000 is a highly portable, advanced, versatile, user-configurable SCSI Bus Analyzer. This instrument was designed for the following applications:

- development work in the laboratory
- production test
- field service applications

The Ultra-2000 Tracer/Analyzer provides a comprehensive SCSI event tracer, debugger with powerful triggering capability, and an optional SCSI initiator emulator. It provides displays of SCSI bus activity in a variety of formats for easy interpretation.

1.2 GENERAL DESCRIPTION

The SCSI Bus Analyzer is used for recording activity on the SCSI Bus to which it is non-intrusively connected. Its circular buffer can hold up to 32K events (standard for Ultra-2000/Ltx), 128K events (standard for Ultra-2000/BDx), or 512K events (optional). The recording method is 'event driven'; only valid data or transitions on certain SCSI signals are recorded. At the time of recording, each event is time-stamped. The recording can later be played back in several forms. It can be displayed on a built-in electroluminescent (EL) flat screen, or sent to a printer to provide a hard copy. Recorded data can be up-loaded to a host computer, and saved on a disk to build a data base for post processing.

The display of recorded SCSI bus activity can be in two basic forms: a "binary" format similar to a time-domain form of logic analyzers, or a "structured" format which is an interpreted "SCSI-English" form, easily understandable. Other, more specialized display formats are also available. See section 3.

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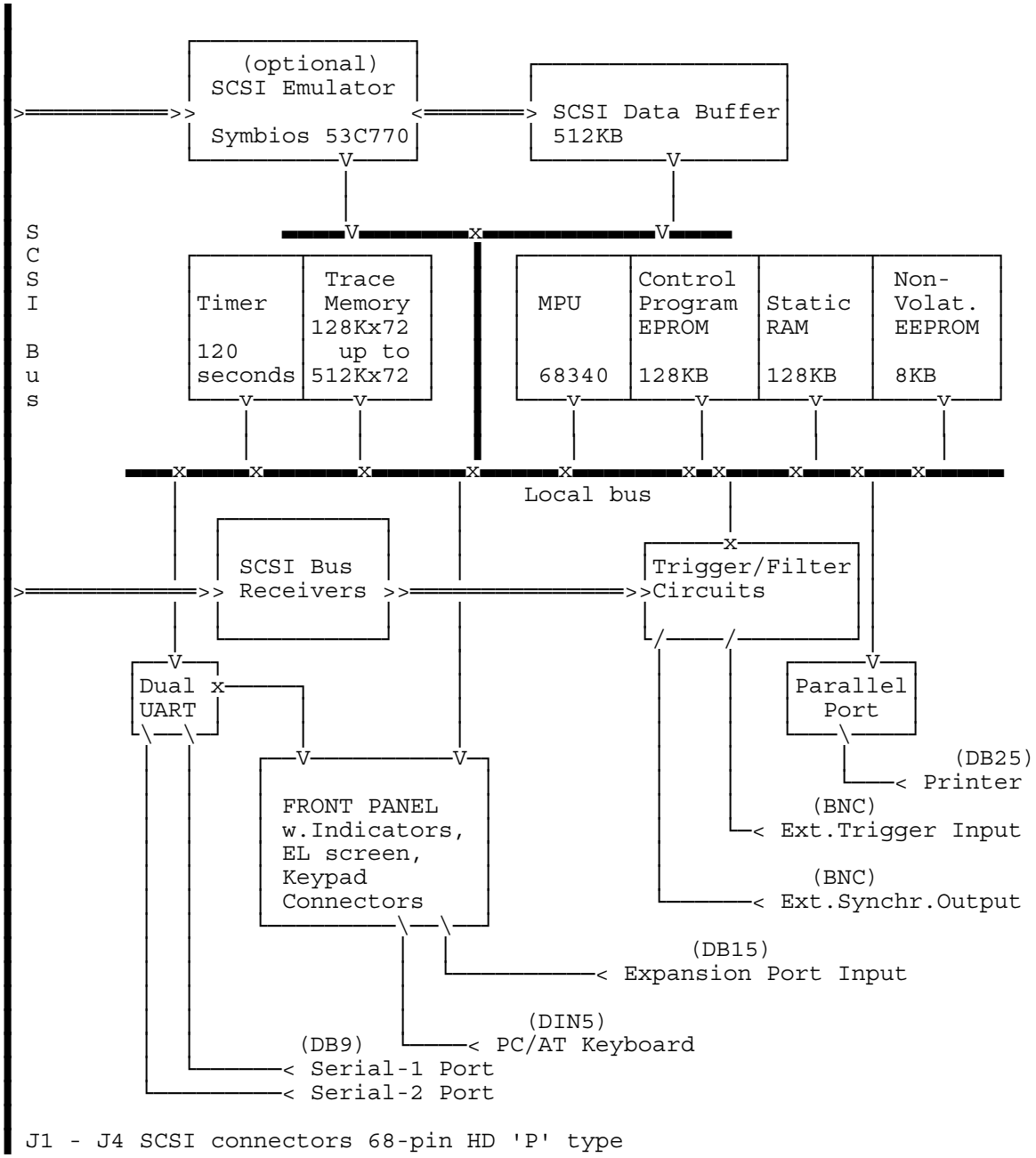
1.3 SYSTEM OVERVIEW

A simplified block diagram of the Ultra-2000 SCSI Bus Analyzer is shown below:



The system carries out several major functions:

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The Tracer/Analyzer unit is connected to the SCSI bus by its line receivers. Note that the tracer is a non-intrusive device, which merely senses activity on the SCSI Bus through isolating receivers. The load on the tested SCSI Bus is less than 25 pF.

From line receivers, the signals are directed to separate circuits: the trace memory, the trigger / filter circuitry, and to the front panel to be displayed using LED indicators. All parts of the Ultra-2000 are internally controlled by the local MPU (Motorola's MC68340) running at 25MHz. The control program for the MPU is saved in EPROM with 64KB capacity, and flash memory with 512kB capacity. An additional 512KB of flash memory is available for user-developed programs.

Communication with the operator is by a built-in keypad, and electroluminescent (EL) flat screen display or a PC for the 'Lite'. A parallel printer may be connected for hard-copy output. In addition, a PC/AT type keyboard can be attached. The Analyzer can also be placed in 'Remote Control' mode, controlled by an external PC or VT-100 type monitor.

Non-volatile EEPROM memory provides for storage of setup parameters, and user option settings.

1.4 TIMING CONDITIONS IN RECORDING

Recording in the Trace Memory is event-driven. This means that only transitions on the SCSI bus are recorded. A valid change (event) is determined by the recording mode, and is defined as follows:

- a positive or negative transition on the BUSY, SEL, ATN, and RST lines,

- during Information Transfer Phases, a SCSI event can be

a) qualified by valid edge of REQ or ACK signals:
During READ operations (Data from Target to Initiator), the status of the SCSI bus signals is recorded in the Trace Memory following the leading edge of REQ signal.
During WRITE operations (Data from Initiator to Target), status of the SCSI bus signals is recorded following the leading edge of ACK signal.

b) recorded during any transition of the REQ or ACK signals, i.e. following all 4 edges of REQ and ACK.

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c) recording of data during data-in or data-out phase can be skipped (after the leading 8/16/32/64/128 bytes). Note that all bytes transferred are counted, and the total count will appear in the trace if the command completes successfully.

d) any transition on the MSG, C/D, or I/O SCSI Control lines can be recorded.

- status of the SCSI bus and 3 external signals can be recorded on every negative transition of the bit-0 of the expansion port.

- certain changes on data lines when tracing the SCAM protocol and during Arbitration phase.

For more on recording modes read Section 2.2.5.

1.5 FRONT PANEL (Ultra-2000/Bxx)

The front panel of the Ultra-2000 contains a flat panel display screen, a 24-key keypad, two push-button switches, and 31 LED indicator lights. Several connectors, a cooling fan, and the main power switch module also share the front panel. See Figure 1.

The **DISPLAY SCREEN** is a high-visibility electroluminescent (EL) flat panel, capable of displaying 25 lines of 80 characters each.

The **SYSTEM RESET** switch is used for restarting the system.

The **SCSI RESET** switch is used for generation of the RESET condition on the SCSI bus.

The **LED indicators** are:

POWER
TRACING
TERMINATOR POWER
PRINT mode
SCSI Control Signals: BUSY, SEL, C/D, I/O, MSG, REQ, ACK, RST and ATN

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SCSI Data Signals: D0 - D15, and Data-Parity (2)
Single-Ended / Differential HVD / LVD SCSI interface

CONNECTORS located on the front panel of the Ultra-2000 are:

- Parallel Printer (DB25 female)
- Expansion 3-bit port Input (DB15, female)
- two Serial I/O ports (DB9 female)
- 5-pin connector for PC/AT keyboard (DIN female)
- External Trigger Input (BNC connector)
- External Synch Output (BNC connector)
- J1,J2 - SCSI connectors (68-pin, female) for S/E interface
- J3,J4 - SCSI connectors (68-pin, female) for Diff HVD or LVD interface

EXTERNAL TRIGGER INPUT - The connector (coaxial BNC type), located on the right side of the front panel of the Ultra-2000 serves for input of an external trigger signal. The Ultra-2000 will trigger on negative transition if enabled from the trigger menu.

The basic trigger functions, which most users would need, have been implemented in the system. Additional unique trigger functions may be added by using this external trigger.

EXTERNAL SYNCH OUTPUT - The J8 connector (coaxial BNC type), located on the right side of the front panel of the Ultra-2000 serves for providing a trigger signal, which may be used for triggering external instruments like oscilloscopes, logic analyzers, etc. See Section 5 for more details.

EXPANSION 3-BIT PORT INPUT - There is often a need to compare the relationship of external signals with the SCSI bus signals. For this purpose, the ("Expansion") connector is available. This input port allows for up to 3 signals to be recorded together with the SCSI trace. This additional data, after being recorded, will be displayed as three "0" or "1" digits, in the BINARY display mode. Pin-1 can be used as a clocking signal if "external clock" is enabled from the recording mode menu.

See Appendix A for the Expansion connector pinout. Note that on this connector there are two pins that carry Vcc (+5V, available up to 100mA), and two pins for GND. The Vcc and GND may be used to power external devices like AD converters, or other adapters.

The integrated **AC POWER MODULE** consists of the AC main switch, fuse and a three-pin receptacle for the AC line cord. The **fuse** is accessible under a cover in the body of the module.

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The **24-key KEYPAD** - allows using keys at three levels: the basic function, the 'ALT' and the 'CTRL' modified function. Note that the keypad and the external keyboard can be used inter-changeably. You can be using both at the same time: press a key on the keypad, press several keys on the external keyboard, go back to the keypad, etc.

The names of keys on the keypad were selected so that their starting letter corresponds to the letter on the external keyboard as close as possible. For example the **<Run>** key is the same as the **<R>**, the **<Stop>** key is the same as **<S>**, etc. The number-keys on the keypad are the 'ALT' set, and the special less frequently used functions are the 'CTRL' set.

The table in Appendix D lists all keys of the keypad, their corresponding keys on the external keyboard, and their functions.

FRONT PANEL (Ultra-2000/LITE)

The front panel of the Ultra-2000/Lite contains the same parts, except for the display screen, the 24-key keypad and the SCSI connectors. The SCSI connectors are located on the right (vertical) side. Functionality is the same, except that an external host, such as a PC, is used for keyboard input and for display.

1.6 NOTATIONAL CONVENTIONS

The primary operator interface with the Ultra-2000 is through the keypad on the front panel, or through the PC/AT keyboard. In this manual the following notation is used when referring to keys and key sequences:

Keys are referred to by their legend, enclosed in angle brackets "<" and ">". Examples: **< Esc >**, **< Enter >**, **< Run >**, **< R >**, **< SP >** (for "space" key) etc.

Keys that are to be depressed together (the "control combinations") are shown with a "^" (Up-Arrow) preceding the other character. For example <^C> or <Ctrl-C> means that you type the "C" key while the Ctrl key is depressed. Combinations may also appear as e.g., **<Alt-C>**, which means that you type the "C" key while the <Alt> key is being depressed.

In menus or in various prompts, the optional suggested selections are displayed in parentheses. Current selections or defaults are displayed in square brackets "[", and "]".

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1.7 USER INTERFACE

The user interface is via **screen** and **keypad** built into the front panel on the Ultra-2000, via an external keyboard (connected to Serial-1), or via screen and keyboard of a remote control PC/CRT.

The **SYSTEM RESET** switch, on the lower left side of the Ultra-2000 front panel, if pressed, will reset the system to its initial Power-On state. Remember that selected setup values, stored in EEPROM non-volatile memory, do not change after reset, or if the system is powered OFF. The SYSTEM RESET switch does NOT generate Reset on the SCSI bus.

SCSI RESET switch, near the SYSTEM RESET switch, if pressed, will generate Reset condition (continuous level) on the SCSI bus; however, it will not affect operation of the Ultra-2000.

LED indicators on the front panel display instantaneous status of the SCSI data lines and SCSI control lines. These indicators will typically be useful during a major malfunction, when the object system stalls. In these situations the LEDs will help to determine which SCSI bus phase the system is stopped in, and what condition the active SCSI device is waiting for. For example, an Initiator may be trying to select a non-existing Target device and is not receiving a BUSY signal, or Target may be asserting REQ signal for a data transfer, and is waiting for ACK from the Initiator.

The **TERMPWR** LED indicates whether TERMINATOR POWER is being supplied on the SCSI bus, and that it is 4.0 Volt or higher. It is the responsibility of the system integrator to decide which device will supply it. This TERMPWR LED may be an important indicator, because without the TERMINATING POWER applied, the SCSI bus may still work, but its reliability may be affected. Also remember, that some SCSI bus configurations drive their terminators internally and do not need to drive the TERMPWR line on the SCSI bus.

The **TRACING** LED indicator lights up when the Ultra-2000 is in the tracing mode following **<R>** (RUN). It will stay ON until the tracing is stopped either by the **<S>** (Stop) key, the **<P>** (Pause) key, or as a result of a trigger condition.

The **POWER** LED indicates that the Ultra-2000's power is turned ON.
The operator interface from the keypad, or from the external PC/AT keyboard, is completely menu-driven. The main menu at the root of the Ultra-2000 firmware system serves for selection of functions related to tracing, trigger selection, and display of recorded data.

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Most of the functions are actuated by a single key stroke; selection is recognized by the system, and the rest of the word is filled in automatically. The function will execute, or if more input is needed, a menu or prompt will appear on the screen. If a wrong key is pressed, the system will either beep, and give the operator a second chance, or in some situations will abort and exit that function. The type of each individual operation will determine which of the two actions will be taken.

Several keys have characteristic functions:

By pressing **<Enter>, <Space>**, or **<Yes>** while at the root level, the main menu will be re-displayed.

<Q> or **<q>** keys will cause exit from a current function, or exit the current menu, and stepping one level back. By repeating the **<Q>/<q>**, eventually you will return to the main menu at the root. The **<Esc>** or **<Quit>** from the keypad have similar effect.

<^C> There may be several prompts to be answered before a certain function is started. If you change your mind in the middle of this selection process, then by pressing the **<^C>** key you can quit that selection sequence and exit immediately to the root. You can also use the **<^C>** to exit any selection and return directly to the root menu level.

<Pause> or <^S> causes the system to pause. Press **<^Q>** to continue.

<^Print> or <^P> is a toggle switch which will turn "parallel printing" ON or OFF. Printing mode is indicated by a small LED at the **<^Print>** key. By "parallel printing" we mean sending all data that is being displayed on the screen also to the printer port. Note that only the trace data will be printed (not the menus etc.).

Note that the keys **<^C>, <^S>**, and **<^P>** work the same as on any PC system.

OTHER GENERAL RULES:

If a question is asked in a selection dialog expecting a "Y/N" answer, use keys marked **<Yes>** and **<No>** from the keypad. If an external keyboard is used, typing a "Y" is interpreted as YES, and anything else is interpreted as NO (in some cases, 'N' is interpreted as NO, all other responses are rejected).

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In edit sessions typically the current selection is displayed. If a different value is required, the operator should type it in. If only **<Enter>** is typed, the current value will stay unchanged. By typing "." (period), **<Esc>**, or **<Q>** the edit session is terminated.

Numeric values, except the timing information (e.g., Time-Stamp), or unless marked, are displayed in Hex format. Similarly, all numeric answers are expected to be in Hex unless marked otherwise.

Currently selected values are displayed in "[ ]" brackets. If such a value appears at the cursor for input, typing **<Enter>** selects that value.

From menus displaying a highlighted entry, the arrow keys move the highlight from one entry to the next. Most menu selections also have a "selector" key, which will move the highlight directly to that entry.

1.8 TIMER AND TIME-STAMPING OF RECORDED SCSI EVENTS

There is a 4-byte, 33 MHz counter in the Ultra-2000 Analyzer which is used for marking each recorded event in trace memory with a time stamp. The resolution is 30 nanoseconds. The timer will wrap around after 120 seconds. The REQ/ACK signals are sampled each 1/4 cycle (7.5 ns) to give finer granularity resolution.

The time stamp is displayed together with the recorded data in the BINARY display format. It can be selected to show as time differential (time increment from the previous event), or as time elapsed from the beginning of the tracing (including possible 2-minute wrap-arounds). This selection is done from the keypad by pressing the **<^TmFmt>** key while in the display mode. Timing information is also available in the STRUCTURED display. When enabled, the duration of each phase will be displayed on the last line of that phase, if space permits.

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1.9 ELECTRICAL CONNECTION ON THE SCSI BUS

There are three alternatives for connecting the SCSI bus: the SINGLE-ENDED and DIFFERENTIAL HVD (High Voltage Differential) and LVD (Low Voltage Differential) connectors. Pinouts of all connectors used are listed in Appendix A.

'SCSI FACTS & TIPS' in Appendix J. is a recommended reading for those interested to know more about the S-E and Diff interfaces.

1.10 SCSI Bus TERMINATION AND TERMINATION POWER

There is no internal termination provided. Use external SCSI DIFFERENTIAL HVD or LVD Terminator. Power (TERMPWR) for this Terminator is supplied in all SCSI connectors, the J1 through J4.

The TERMPWR is protected by a serial (Schottky) diode for protection against back flow, and by a 1.0 Amp fuse for protection against electrical short. The fuse acts as a circuit breaker with automatic reset. In case of a short on TERMPWR, the breaker disconnects the circuit; when the short is removed, the breaker restores TERMPWR within 20 seconds.

!!! WARNING !!!

NOTE THAT IF TERMPWR IS SUPPLIED BY MULTIPLE SOURCES TO THE SCSI BUS, AND IF ACCIDENTALLY THE 'TERMPWR' PIN OF THE SCSI BUS CABLE GETS GROUNDED, THEN THE 'TERMPWR' LEAD OF THE SCSI BUS CABLE WILL HAVE TO WITHSTAND THE SUM OF THE CURRENTS FROM ALL THE SOURCES 1 AMP EACH (EACH FUSED AT 1 AMP) BEFORE THE FUSES BEGIN TO FAIL !

As a rule, there should be exactly two terminators on a SCSI bus, one on each physical end. Therefore, before connecting the analyzer to a system to be tested, see whether you should add the terminator. This depends on where you are connecting the analyzer - in the middle or at the physical end of the SCSI cable.

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'SCSI FACTS & TIPS' in Appendix J. is a recommended reading for those interested to know more about the S-E or Diff interfaces, and SCSI bus termination methods.

1.11 TECHNICAL SPECIFICATIONS

- Compatible with SCSI specifications as defined by the ANSI X3T9.2 committee for SCSI-1 and SCSI-2, and the current draft SCSI-3 SPI/SIP, including Fast/20.
- Asynchronous data transfer rates to over 6 MB/s
- Synchronous data transfer rates to over 20 MB/s
- Single-ended (SE) interface, differential HVD (High Voltage Differential), and LVD (Low Voltage Differential) interfaces are standard. All SCSI connectors are the 68-pin female type for wide interface. Use 68-to-50 pin adapter for the narrow interface.
- Non-intrusive tracer. Only signal changes are stored, therefore recording time is not limited
- Trace memory is 32K events (Ultra-2000/Lite) or 128K events (Ultra-2000) deep, and 72 bits wide. Optionally it can be expanded to 512K.
- Up to three external signals can be recorded together with SCSI in the trace memory to allow to allow tracing in the tested device. External port pin-1 can be used as "clocking" (both edges are used)
- Recording modes: record all, or skip data, record one or all four edges of REQ and ACK, phase changes, capture expansion port changes, and filtering by SCSI ID, recording of selections only, or recording of SCSI-3 SCAM protocol.
- Display of recorded trace data in several formats: in structured (Pascal-like) expanded or compact form, binary, hexadecimal, or Command Profile format.
- Hard copy of all displays printed via parallel I/O port (parallel printer) on an optional printer
- Event time-stamping function up to over 120 seconds before timer counter wrap around, with 30 ns (7.5 ns for REQ & ACK) resolution
- Non-volatile EEPROM memory for storage of current setup and mode parameters
- 128K-byte (SRAM) system or program memory, and 512K-byte data read/write SCSI buffer
- Motorola 68340 local MPU, at 25 MHz, with resident firmware in 64K byte EPROM and 1MB of flash memory.
- Configuration selectable through menu driven software, stored in non-volatile EEPROM memory

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- Two Serial I/O ports (RS-232) with selectable baud of up to 115K baud with data format and parity options
- Powerful triggering capability is menu selectable: delayed-trigger (trigger position in trace) internal triggering by: selected command, status or message pattern/code combination of command and status and ID, or message and ID

(re)select, (re)select timeoutdata parity error
Trace Memory is full (post-trigger)
External triggering through trigger-input BNC connector
External synch (trigger) output through a BNC connector

- Physical dimensions: 11"W x 14.5"D x 5"H. Weight: 13 lbs
- Housed in a transportable high-quality fan-cooled attaché case type enclosure, with

detachable top cover. Built-in EL flat screen & keypad, and switching power supply for 110-220 Volt, 50-60Hz operation. Storage pouch in cover is for small keyboard, cables, adapters, etc.

1.12 SCSI STANDARD SPECIFICATIONS AND REFERENCES

1.12.1 SCSI STANDARD SPECIFICATIONS

Mechanical, electrical and functional definitions of the SCSI-1 are described in:

SCSI-1 Specification is Number: ANSI X3.131-1986
Title: Information Systems - Small Computer Systems Interface (SCSI)

Can be purchased from:
American National Standards Institute, Inc. (ANSI)
1430 Broadway, New York, N.Y. 10018
phone: (212)642-4900, Fax: (212)302-1286

SCSI-2 and SCSI-3 (SIP & SPI) Specifications are available from:
GLOBAL ENGINEERING DOCUMENTS,
3130 South Harbor Blvd, Suite 330, Santa Ana, California 92704
(800)854-7179 or (303)792-2181, Fax: (303)792-2192

Refer to document X3.131-1994.

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1.12.2 OTHER LITERATURE

Basics of SCSI - Third Edition by ANCOT
a quick introduction to SCSI, SCSI terms description, and glossary.

Available from ANCOT Corporation
115 Constitution Drive, Menlo Park, CA 94025
(415) 322-5322
This publication is FREE

The Book of SCSI by Peter M. Ridge
contains chapters on anatomy of SCSI, connecting SCSI HW, installing SCSI in a PC, troubleshooting, cables, ASPI programming, CAM, etc.

Available at many bookstores, or purchased directly from:
NO STARCH PRESS
1903 Jameston Lane, Daly City, CA 94013-3466
(415)334-7200

1.12.3 INTERNET RESOURCES

http://www.ancot.com
http://www.std.com

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SECTION 2

TRACER / ANALYZER FUNCTIONS AND COMMANDS

2.1 TRACE MEMORY

Trace Memory is a circular buffer 128K (or 32K for LITE), optionally 512K events deep, with each event 72 bits wide. The 72 bits are used as follows:

2 bytes (16 bits) for SCSI data
2 bits for low and high data parity error flags
6 bits for SCSI control signals (BSY,SEL,RST,MSG,C/D,I/O)
4 bits each (12 bits total) for fast SCSI control signals (REQ,ACK,ATN)
4 bytes (32 bits) for the time stamp
3 bits for expansion port
1 bit for internal use

Trace Memory is used in a very efficient way: only valid data, and transitions on certain SCSI bus signals cause recording. The qualifier for Data, Command, Status, and Message recording is REQ or ACK strobe. In standard recording mode, when REQ for DATA-IN is asserted, or ACK is asserted for DATA-OUT, a snapshot of the SCSI bus (within less than 20 ns) is taken, latched, and written in the trace memory. Other recording modes are available. See Section 2.2.5.

There are several SCSI control signals which cause recording whenever a transition on these is detected. They are: RST, ATN, SEL, and BUSY. Again, as with the data, a snapshot of the SCSI bus is taken at the time of the transition (within 20 ns) and the event is subsequently recorded in the trace memory.

The recording can be started or stopped in one of two ways:

a. - without trigger: operator starts recording by typing **<R>**, and stops it by **<S>**
b. - with trigger, either immediate or delayed

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Whether recording with or without trigger, the **<Run>** (**<R>**) command has to be used to set the Ultra-2000 in the TRACING mode. This mode is indicated by the "TRACING" LED on the front panel and a "RUN" message on the screen. When activity on the SCSI bus starts, the trace memory starts filling. When the memory is full, it will wrap around and continue writing from the physical beginning. The recording will continue until stopped by the **<Stop>** (**<S>**) key, or by a post-trigger condition, if enabled. At that point the current (internal) trace memory physical address is detected, and beginning of valid data is calculated. This is done automatically without operator intervention. The earliest event still in the trace is at logical address $00000. The operator does not have access to the physical address however, but deals with logical addressing only.

When recording with trigger disabled (internal or external), the trace memory acts as a FIFO buffer. The recording starts with the first SCSI activity following **<Run>**, and continues until stopped by **<Stop>**. If trace memory (physical) capacity is exceeded, it wraps around and starts writing from the physical beginning. Although the trace memory uses internally a linear physical address space, the internal firmware translates physical address to logical before displaying it, to make the trace memory appear circular. When recording is stopped, it reports "STOPPED AT xxFFF(WRAP)". The last recorded event is at trace memory (logical) address 7FFF (1FFFF in 128K, or 7FFFF in 512K versions).

When trigger is used, recording starts as described above, and continues until a trigger condition occurs. When the trigger finally occurs, then depending on trigger delay selection, the recording either:

- stops immediately
- continues to the end of the current command when BUS-FREE Phase is detected
- or records a certain number of additional events before stopping (delayed trigger)

However, when "Trigger on Trace Memory full" is selected (select delay = 100% and "Trigger on RUN" line in trigger menu), or External Trigger is used and the last location is filled, recording stops immediately.

TRACING will stop immediately, without any delay, when the **<Stop> (<S>)** key is pressed.

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2.2 FUNCTIONS AND COMMANDS

2.2.1 MAIN MENU

The main menu lists the basic functions of the SCSI bus tracer. From this level various sub-menus can be accessed. As with all menus, selections can be made as follows :

- By moving the highlight bar to the desired entry using the arrow keys and then pressing **<Enter>**.

- By pressing the selector key, shown either in angle brackets <> at the start of the line before the entry, or by an typing the underlined character in the item text.

- In some cases, letter keys from the PC/AT keyboard act as selector keys.

```
                          Ultra-2000 MAIN MENU
_____________________________________________________________________________

        TRACING                 TRACE MEMORY                 UTILITIES

<Run  > start tracing       <1> - Clear trace          <6> - <^Find> event
<Pause> tracing             <2> - R/W trace to disk    <7> - Calc.<^Time> diff
<Stop > tracing             <3> - Save/Restore trace   <8> - <Util>ities
<Mode > of tracing          <4> - <Display> trace      <9> - SCSI Emulator
<Trig >ger setup [Pre ]     <5> - Setup display format <A> - User Program
```

2.2.2 <R> - START TRACING (RUN)

Pressing the **<Run>** key puts the Ultra-2000 into tracing mode. From that point on, all activity on the SCSI bus will be recorded, subject to the trigger conditions in force. From the external keyboard, the **<R>** key is a selector for this function.

See Section 2.1 for a discussion of tracing itself.
See Section 2.2.5 for a discussion of recording modes.
See Section 2.2.6 and Section 5 for a discussion of triggering.

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2.2.3 <P> - PAUSE TRACING

Pressing the **<Pause>** key temporarily halts recording of SCSI bus activity. Pressing **<Run>** will then restart recording. A message "Tracing PAUSE at **<addr>**" will appear. The 'seam' location will be marked in the trace memory, and can later be found using the 'Find Event' command. From the external keyboard, the **<P>** key is a selector for this function.

2.2.4 <S> - STOP TRACING

Pressing the **<Stop>** key will halt tracing. From the external keyboard, the **<S>** key is a selector for this function.

2.2.5 <M> - MODE OF TRACING

Press the **<Mode>** key to select the recording mode from the TRACE MODE SETUP menu as shown below. From the external keyboard, the **<M>** key is a selector for this function.

```
     TRACE MODE SETUP MENU
_____________________________________
<0> - Save All/Skip Data              [All]
<1> - Capture phase changes           [ ]
<2> - ID Filtering      [0081]        [ ]
<3> - Capture Selection Only          [ ]
<4> - Capture 4 Edges REQ/ACK         [E]
<5> - Capture on Exp(0)               [ ]
<6> - Capture SCAM protocol           [ ]

Your selection (0../Quit) ?
```

Individual functions are described below.

2.2.5.1 <0> - SAVE ALL / SKIP DATA

This entry allows selection of the 'Skip Data' recording mode. Number in the brackets shows the number of data transfers which will be recorded. When this function is disabled, 'All' will be indicated. If 'Skip Data' is enabled

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(selected by the left and right-arrow keys) then either 8, 16, 32, or 64 in the brackets indicate that only so many data transfers will be recorded. In either case, the total number of data transfers is counted and recorded in the trace memory, and will appear in the structured display. Skipping data does not inhibit the transfer of data across the SCSI bus. Only recording is affected.

2.2.5.2 <1> - CAPTURE PHASE CHANGES

This entry enables or disables the recording of transitions on the SCSI control lines : MSG, C/D and I/O. When enabled, an 'E' character appears in the set of brackets, and any transition on the information transfer phase-determining lines is recorded as a SCSI event. When disabled, transitions on these lines do not cause an event to be recorded.

2.2.5.3 <2> - FILTERING BY SCSI ID

This entry enables or disables the Filter mode of recording. When enabled, the tracing circuits will record all transactions up to and including the selection phase. However, unless the pattern of ID bits during the selection phase matches the user-defined pattern, all other activity until the next Bus Free state will not be recorded. Note that it is the exact pattern of bits during Selection phase that determines whether later events are recorded. Therefore you can choose to observe only events between a particular pair of devices.

The following example is provided to clarify this subject. Assume the bus being monitored has Initiators as ID 6 and ID 7 and Targets as ID 0, ID 1 and ID 2. You might think that you could capture all traffic to Target ID 1 from both Initiators. However, if you try this by setting only bit number 1 in the pattern, that pattern will never be matched, since both the Initiator's and Target's ID numbers are set during Selection phase. You might also try setting bits 1, 6 and 7. That will not work either, since only two bits may be set during selection phase. You can, however, capture all transactions

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between a pair of ID numbers, for example ID 0 and ID 6. You could even capture only transactions between ID 0 and ID 2 (although this situation would be questionable, since both of those ID numbers belong to Targets).

When this function is enabled, you are allowed to set the bit pattern to match. Note that 16 bits are provided in the pattern. This is to allow matching of SCSI WIDE Selection IDs. The default pattern is for ID 7 (commonly used by Initiators) and ID 0 (commonly used by Targets), and shows as the pattern [0081] in the menu.

2.2.5.4 <3> - CAPTURE SELECTION ONLY

This function enables or disables skipping of all events except transitions on the SCSI BSY and SEL control lines. This mode is extremely economical of trace events when all that is desired is to see which IDs are being most utilized, or to determine the proportion of idle to active time on the bus.

2.2.5.5 <4> - CAPTURE FOUR EDGES REQ/ACK

This function enables or disables capture of an event on any transition of the REQ or ACK SCSI control lines. When enabled, each transfer of information during the Command, Status, Message or Data phases will cause up to four events to be recorded (on some extremely fast systems, two of the edges may occur so close together as to be telescoped into one recorded event). This recording mode is very valuable in tracing synchronous data transfers, or when checking timing of the REQ and/or ACK signals.

When this function is disabled, the tracer will record only one event for each byte of information transferred. The recording will be qualified by the edge of REQ or ACK that signifies valid data : the transition to active REQ for data from the Target, or the transition to active ACK for data to the Target.

2.2.5.6 <5> - CAPTURE ON EXP(0)

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This function enables or disables recording of events when Exp(0) changes. When enabled, any transition (up or down) on expansion connector bit 0 (DB-15 type connector, pin-1) will cause recording of a snapshot of the SCSI bus (within 30 ns of the transition). This mode is useful to relate the timing of signals internal in tested system to the contents of the SCSI bus.

2.2.5.7 <6> - CAPTURE SCAM PROTOCOL

This mode allows recording of events during the auto-configuration process of the SCSI-3 SCAM Protocol. In this mode, whenever both BSY and SEL signals are active, transitions on D5, D6, or D7 (the SCAM Handshake lines) cause an event to be recorded. Since transitions on the certain data lines cause recording (which in normal trace mode would be ignored), more of the trace memory is used than in the normal trace mode.

The reader is referred to Appendix E and the SCSI-3 ANSI specification (document: SCSI-3 Parallel Interface 'SPI', Annex B) for detailed description of the SCAM protocol.

2.2.6 TRIGGER SETUP

Press the **<Trig>** key on the keypad to specify the trigger mode and conditions of the trigger event. From the PC/AT keyboard, the **<T>** key is a selector for this function.

See Section 5 for a complete discussion of the Trigger Setup Menu and triggering.

2.2.7 <1> - CLEAR TRACE

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The CLEAR TRACE function is a two-step operation. When selected, a prompt will appear, asking you to confirm that the trace memory should be cleared. If you press **<Yes>** on the keypad, or **<Y>** on the external keyboard, the trace memory will be cleared to all zeros. From the PC/AT keyboard, the **<C>** key is a selector for this function.

2.2.8 < 2 > R/W TRACE TO DISK

The R/W TRACE TO DISK function allows you to save traces and setup parameters to the hard disk in the Ultra 2000. There are also commands for manipulating files and directories on the disk. When you press "2" or "w" from the Ultra-2000 main menu, the following menu will appear.

R/W TRACE TO DISK / DISK OPERATIONS

KEYPAD COMMANDS	KEYBOARD COMMANDS	
<0> - Write Trace to disk	wt	write trace
<1> - Read Trace from disk	rt	restore trace
<2> - Write setup to disk	ws	write setup
<3> - Read setup from disk	rs	restore setup
<4> - List files	dir	directory listing
	copy	copy file/dir
	del	remove file/dir
	attrib	change attributes
<5> - Change Directory	cd	change directory
	mkdir	make directory
	move	move file/dir
	diff	compare files
<6> - Format Disk	format	format disk

The up and down arrows on the keyboard or keypad will scroll through the numbered selections (**<1>** - **<6>**) on the left hand side. You may also enter one of the numbers directly to highlight your desired selection. When you press "Enter", the highlighted selection will be run. Notice that some commands require the use of a keyboard.

To access the keyboard commands, select "**<4>** - List files" or type "dir" at the prompt. This will clear the screen and show the familiar DOS directory display followed by a prompt (e.g. "\>" for the top directory). It is suggested that you make a "traces" directory and a "setup" directory in order to keep saved files better organized.

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If you type "?" or "help" at the keyboard "\>" prompt the following help menu will be displayed.

```
\>: help
        Command     Description        Parameters
        ?,HELP      Help
        CD          Change Directory PATH or CD to display CWD
        COPY        Copy file        FROMPATH TOPATH
        DEL         Delete file/dir  PATH
        DIFF        Compare files    PATH PATH
        DIR         Directory listing  PATH
        FORMAT      Format Disk
        MKDIR       Make Directory   PATH
        MOVE        Move file/dir    PATH NEWNAME
        ATTRIB      Change attributes
                        PATH RDONLY|HIDDEN|SYSTEM|ARCHIVE|NORMAL
        WT          Write Trace      START END PATH
        WS          Write Setup      PATH
        RT          Read Trace       PATH
        RS          Read Setup       PATH
\>:
```

2.2.8.1 KEYPAD COMMANDS

<0> - Write Trace to disk

Write a trace or part of a trace to the disk. The address range of the current trace in memory is displayed in braces and may be changed. A file name in braces is suggested in the form of date_number.trc" (e.g. 0225_001.trc). This may also be changed.The ".trc" extension is only a suggestion for trace files. Any DOS filename may be used. The menu is shown below

```
    WRITE TRACE TO DISK

    Address range:  [00000] - [007c2]
    Path/filename:  [\TRACES\0225_005.TRC..............]
```

Pressing "Enter" writes the trace to the disk and "ESC" cancels the operation.

<1> - Read Trace from disk

Read a trace from the disk to trace memory. After reading the trace from disk to trace memory, the trace may then be viewed in the normal manner. As shown in the menu below, two windows are presented. The left hand window lists files

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and the right hand window list directories. Movement between the windows is with the left or right arrows. Scrolling up and down is done with the up or down arrows. The current selection is shown in reverse video. To accept the selection, press Enter.

```
SELECT FILE OR CHANGE DIR

Files          Dirs
trace1.trc      ..
0225_000.trc
0225_001.trc
0225_002.trc
```

<2> - Write setup to disk

This saves all the current setup parameters to the current directory on the disk. The parameters include mode, trigger, utilities and emulator variables. For example, you could setup certain trigger conditions and save them with the **ws** command (**ws mytrig**). You could then read the settings back at a later time using the **rs** command (**rs mytrig**).

A file name in braces is suggested in the form of date_number.set" (e.g. 0225_001.set). This may also be changed. The ".set" extension is only a suggestion for setup files. Any DOS filename may be used. The menu is shown below:

```
WRITE SETUP TO DISK

Path/filename [\setup\-224_001.set.................]
```

<3> - Read setup from disk

Read a setup file from the disk and change setup parameters. After reading the setup from disk, the new setup parameters take effect immediately. As shown in the menu below, two windows are presented. The left hand window lists files and the right hand window list directories. Movement between the windows is with the left or right arrows. Scrolling up and down is done with the up or down arrows. The current selection is shown in reverse video. To accept the selection, press Enter.

```
SELECT FILE OR CHANGE DIR

Files          Dirs
setup1         ..
0225_000.set
```


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```
0225_001.set
0225_002.set
```

<4> - List files

This will clear the screen and display a list of files in the current directory (see below). The display includes the time and date of creation and the size of the file. Following this, a prompt showing the current working directory is shown. To return to the menu prompt, enter return. To run other commands, enter the command at the prompt.

```
TRACES    .             <DIR> 02-24-97 16:46
SETUP     .             <DIR> 02-24-97 16:47
TEMP1     .     4,608         02-25-97 13:00
TEMP2     .     4,608         02-26-97 12:34
     3  File(s)   540,123,456 bytes free
\>
```

<5> - Change Directory

This will allow you to change the current working directory. As shown in the menu below, two windows are presented. The left-hand window lists files and the right hand window list directories. Movement between the windows is with the left or right arrows. Scrolling up and down is done with the up or down arrows. The current selection is shown in reverse video. To accept the selection, press "Enter".

```
SELECT FILE OR CHANGE DIR

Files         Dirs
TEMP1         SETUP
TEMP2          TRACES
```

<6> - Format Disk

This will format the hard disk. An additional prompt will allow you to confirm your intent to format the disk.

WARNING: Format will erase the contents of the hard disk.

2.2.8.2 KEYBOARD COMMANDS

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?,HELP Help

The "?" or "help" commands display a brief list of the commands and their parameters.

CD Change Directory

"cd" by itself will display the current directory path. "cd" with a path will change to the selected directory.

EXAMPLE:
cd traces - This will change to the "traces" directory.
cd \ - This will change to the root directory.

COPY Copy file/dir

"copy" will copy one file to a new file. If the new file already exists, the copy will not take place and a warning will be printed.

EXAMPLE:

□□□□.□□□□□□.□□□□□□.-.□□□□.□□□□.□□□□..□□□□□□..□□..□□□□□□.

DEL Delete file/dir

Delete a file or directory. A directory must be empty in order to delete it. The "del" command will not delete files with the RDONLY attribute set.

EXAMPLE:
del trace1 - delete the file "trace1"

DIFF Compare files

Compare two files to see if they are the same. This will not show differences, but will simply compare them.

EXAMPLE:
diff trace1 trace2 - compare file "trace1" with file "trace2"
(TRACE1) (TRACE2) Files are the same

DIR Directory listing

This will display a list of files in the current directory. The display includes the time and date of creation and the size of the file.

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FORMAT Format Disk

This will format the hard disk. An additional prompt will allow you to confirm your intent to format the disk.

WARNING: Format will erase the contents of the hard disk.

MKDIR Make Directory

Create a sub directory in the current directory.

EXAMPLE:
mkdir mytrace - creates the directory “mytrace’

MOVE Move file/dir

This renames a file or directory.

EXAMPLE:
move trace1.trc mytrace.trc - moves (renames) “trace1.trc” to “mytrace.trc”

ATTRIB Change attributes

This allows you to examine or change a file=s attributes. If no attributes are given, the file=s current attributes are displayed. The attributes are RDONLY, HIDDEN, SYSTEM, ARCHIVE, NORMAL. The DIRENT attribute is reserved for directories and cannot be changed. At the present time, only the presence or absence of the RDONLY attribute is used.

EXAMPLES:
attrib mytrace - list the attributes of the file “mytrace”
Attributes: ARCHIVE

attrib mytrace rdonly - make the file “mytrace” read only

attrib mytrace - list the attributes of the file “mytrace”
Attributes: ARDONLY|ARCHIVE

attrib mytrace normal - remove all file attributes

attrib mytrace - list the attributes of the file “mytrace”
Attributes: NORMAL FILE (No bits set)

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WT Write Trace

Write a trace or part of a trace to the disk. You must supply the start and end addresses of the trace or you may use the default dash "-" for either or both addresses. If the end address of the trace is past the end of the current trace, the end of trace address will be used.

EXAMPLES:
wt 0 1ffff trace1 - saves the entire trace to disk in file "trace1".
wt - - trace1 - saves the entire trace to disk (using default addresses) in file "trace1" wt 1000 2000 trace1 - saves trace from address 1000 to 2000 to disk in file "trace1".

WS Write Setup

This saves all the current setup parameters to the current directory on the disk. The parameters include mode, trigger, utilities and emulator variables. For example, you could setup certain trigger conditions and save them with the ws command (ws mytrig). You could then read the settings back at a later time using the **rs** command (**rs mytrig**).

EXAMPLE:
ws setup1 - saves current setup to disk in the file "setup1".

RT Read Trace

Read a trace from the disk to trace memory. After reading the trace from disk to trace memory, the trace may then be viewed in the normal manner.

EXAMPLE:
rt trace1 - read "trace1" from the disk to trace memory.

RS Read Setup

Read a setup file from the disk and change setup parameters.

EXAMPLE:
rs setup1 - read "setup1" from the disk and update all parameters.

2.2.9 <3> - SAVE/RESTORE TRACE

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The SAVE/RESTORE TRACE functions allow you to place some or all of the current recorded trace of SCSI bus activity into a file on an external computer, or into the optional Trace Mirror memory. This functions also allow you to read from a previously stored trace back into the active trace memory for display. See Sections 2.3 for description.

2.2.10 <4> - DISPLAY TRACE

The DISPLAY TRACE function allows you to see the activity recorded while tracing. See Section 3 for a complete discussion of the display modes and how to interpret the various parts of the display. From the external keyboard, the **<D>** or **<3>** key is a selector for this function.

2.2.11 <5> - SETUP DISPLAY FORMAT

This function allows you to specify how the recorded activity is displayed. See Section 3 for a complete discussion of the display modes. From the external keyboard, the **<F>** or **<4>** key is a selector for this function.

2.2.12 <6> - FIND EVENT

This function searches the trace memory for a particular pattern of control or data bits. See Section 5 for a complete discussion of the searching function. Note that searching is accessible from the trace display mode as well, by pressing the **<^Find>** key. From the external keyboard, the **<Ctrl-F>** key combination is a selector for this function.

The **FIND-NEXT** function repeats a previous search for the next matching event. If no previous search was made, it searches for the next Bus Free event. Note that this function is also accessible from the trace display mode, by pressing the **<^FndNxt>** key. From the external keyboard, the **<Ctrl-L>** key combination is a selector for this function.

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A **FIND-PREVIOUS** function is also available. Press **<^FndPrv>** to select it. It is similar to FIND-NEXT, but it searches backwards through the trace. From the external keyboard, the **<^K>** is the selector for this function.

The **FIND EVENT** function can use a occurrence count, i.e., you can find the nth occurrence of a certain event. The **FIND-NEXT** or **FIND-PREVIOUS** will always find the next first occurrence, however.

2.2.13 <7> - CALCULATE TIME DIFFERENTIAL

This function allows you to select two trace events by specifying their addresses, and calculates the elapsed time between the two events. It uses the 20 nanoseconds resolution timestamp. Note that the time in nsonds is approximately modulo 170 seconds, due to timer counter wrap-around. In other words, if the two events are actually 175 seconds apart, the difference reported will be approximately 5 seconds. This function is also accessible from the trace display mode by pressing the **<^Time>** key. From the external keyboard, the **<Ctrl-T>** key combination is a selector for this function.

2.2.14 <8> - UTILITIES

This function allows access to utility functions which do not fall into any other category. See Section 7 for a complete discussion of the miscellaneous utility functions. Press the **<Util>** key to access this function. From the external keyboard, the **<U>** key is a selector for this function.

2.2.15 <9> - SCSI EMULATOR

Press the **<9> or <E>** key to enter the optional SCSI Emulator menu. See Section 6 for a detailed description of all of the SCSI Initiator Emulator functions.

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2.2.16 <A> - USER PROGRAMS

Press **<A>** to start a user program. Such programs include ANTEST (a package, sold as an optional disk testing utility by ANCOT), other user programs provided by ANCOT, or programs developed using the C cross compiler developed by ANCOT. See section 9.2.2 for more information on the cross compiler.

Pressing **<A>** results in another option menu.

```
        USER PROGRAM MENU
        _________________________

        <1> - SRAM (load first)
        <2> - SRAM (restart)
        <3> - FLASH (load first)
        <4> - FLASH (restart)

        Your selection (0../Quit) ?
```

Using this menu, you can choose:

1 - to download from host and start a program in SRAM,
2 - to restart (earlier downloaded) program in SRAM,
3 - to download from host and start a program in FLASH, or
4 - to restart (earlier downloaded) program in FLASH.

The SRAM (128KB in all models). It can hold program(s), but is cleared after power up.

The FLASH, up to 512K Bytes, can hold programs which are saved until written over.

Programs are downloaded from the host into the Ultra-2000 using the serial port, at connector Serial-1. You will need a communications package, such as PROCOMM or PLPLUS, on your host computer capable of transmitting files in ASCII format. Also the file must be written in Motorola S-record format, in order to be executed on the Ultra-2000. The cross compiler available from ANCOT produces S-record format files. Finally, you will need a null modem cable (supplied by Ancot in accessories kit) to connect your host computer's serial port to the Ultra-2000 connector. See section 7.3.10 for instructions on setting the serial port parameters.

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To download a program from the host, first start your communications program on the host computer, and set the serial port configuration to match the serial port in the Ultra-2000. Get everything ready so that a single keystroke will start transmitting the file, but do not start transmitting yet.

Next, get the Ultra-2000 ready to receive the file. Do this by selecting a user program from the USER PROGRAM menu as described above, and choose either SRAM (selection **<1>**) or FLASH (selection **<3>**) as the target of the loading operation. Message "Load S-Records now" will be displayed on the Ultra-2000 screen as an indication that the Ultra-2000 is waiting for the downloading to start, and a counter will appear showing the number of S-records transferred, counting from 0.

Now press the key on the host (**<PgUp>** for PROCOMM) to start the transfer. This order of operations is important because some communications programs start by issuing an initialization string to the modem presumed to be connected. Such strings contain characters which could be interpreted as S-records, and could confuse the software in the Ultra-2000 receiving the file. By starting the communications program before setting the Ultra-2000 to receive, the buffer holding any initialization string is flushed out before the file is sent.

If the transfer process seems to hang at the end, you may need to send ASCII character EOT (value 4) from your communications program. You can usually do this by pressing **<^D>** on the host. When the entire file has been transferred, the program will start automatically on the Ultra-2000. You may need to tell your communications program that the transfer is complete. For example, press **<Esc>** if using PROCOMM.

The downloading of program process is similar to downloading the trace ("restoring trace"). Read Appendix H for an example of using the PC and the PROCOMM PLUS program for saving and restoring the trace.

2.3 SAVE/RESTORE TRACE FUNCTIONS

Choosing the **<3>** from the system main menu results in the display of the following.

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```
SAVE / RESTORE TRACE MENU
_____________________________________________-----------------------
<0> - Save trace to host via serial port (ASCII Transfer)
<1> - Save trace to host via serial port (XMODEM Transfer)
<2> - Save trace to host via parallel port (ASCII Transfer)
<3> - Save trace to host via parallel port (XMODEM Transfer)
<4> - Restore trace from host via serial port (ASCII Transfer)
<5> - Restore trace from host via serial port (XMODEM Transfer)
<6> - Restore trace from host via parallel port (ASCII Transfer)
<7> - Restore trace from host via parallel port (XMODEM Transfer)

          Serial port setup:  9600  8N1
          Your selection (0../Quit) ?
```

You will need a null-modem cable connecting the Ultra-2000 (serial port - 1) to your external host computer to use serial save/restore. If using the parallel port, you will also need an IBM PC or compatible, the special ANCOT parallel transfer utility program operating on the PC, and the special ANCOT Parallel Cable Adapter to use parallel save/restore. Selecting the method and direction of trace transfer results in other prompts and menus to lead you through the process.

Only the Raw Data format can be restored from a host computer file back into the Ultra-2000's trace memory. The other save file formats are provided for human-readable archiving. A utility will be available in a C-source and IBM PC executable format for converting from Raw Data to human readable format. Contact the factory for more information.

2.3.1 <0> or <1> - SAVE TRACE TO HOST VIA SERIAL PORT

You can transfer and save a trace captured by the Ultra-2000 to a file on a host computer for later post processing or archival purposes.

At the host computer end, you will need a communications program capable of transferring ASCII files and storing them using the host computer file system. Most UNIX systems provide these programs as system utilities. Apple Macintosh systems and MS-DOS systems will require an add-on program. BITCOM or PROCOMM are perhaps the most popular of these programs for the PC.

The Ultra-2000 must be connected to the host computer using a null-modem cable. See Appendix A.4 for the pinout. Make sure the connections are made and the host is setup for the same baud and data format as the Ultra-2000, as indicated in the SAVE/RESTORE TRACE menu, line just above the "Your Selection

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?" line. In the example above, serial port setup is shown as "9600 8N1", which indicates:

9600 baud, 8 data, no parity, and 1 stop bit.

Select **<0> or <1>** from the SAVE/RESTORE TRACE menu and you will be given a choice of file formats to transfer. For selection **<0>** the following menu will be displayed. The XMODEM transfer uses only the raw trace data format.

```
FILE FORMAT MENU
________________________________

<0> - Raw trace data format
<1> - Structured format
<2> - Binary format
<3> - Hex Dump format
<4> - Compact format

Your selection (0../Quit) ?
```

The 'Raw Data' format is the only format which can be downloaded back into the Ultra-2000 at a later time. This is an encrypted format which ensures that all characters are printable ASCII. See Appendix C for a description of the encryption algorithm.

The other formats are text files which are duplicates of the trace display formats, identical to what appears on the screen of the Ultra-2000. These formats may be useful for comparisons and post-processing of the trace information, but cannot be reloaded into the Ultra-2000. Note that they are not compressed, and files are much larger than the 'Raw Data' format. For this reason, post-processing of 'NON-Raw Data' formats will typically take much longer.

After you select the format, you will be asked for the trace memory range to be saved, then confirm the transfer by pressing **<Yes>** to start communications. Most communications programs can be set to echo received characters to the screen, so you can follow the transfer as it is progressing.

The transfer is completed when the EOT character (04 Hex) is sent to the host. When the EOT is finally received, disable reception at the host end. This will automatically close and save the file with most communications packages.

See Appendix H for an example of using the PC and the ProComm PLUS communication package for saving the trace on a PC host.

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2.3.2 <2> or <3> - SAVE TRACE TO HOST VIA PARALLEL PORT

The parallel port allows faster data transfers, so it may be desirable when handling larger files.

You will need a receiver utility at the host computer to use the parallel port. ANCOT will provide on request such a utility for the IBM PC/AT or newer or compatible computers. The host computer must also have a bi-directional parallel port. See Appendix G for more detail.

2.3.3 <4> or <5> - RESTORE TRACE FROM HOST VIA SERIAL PORT)

A trace saved to a file in 'Raw Data' format or XMODEM format can be loaded back into the Ultra-2000 trace memory for more study. This function is analogous to saving the trace, as described in Section 2.3.2, except that the direction of transfer is different.

Connect the Ultra-2000 to the host using a null-modem cable. At the host computer end, start the communications program and ready it to send either or ASCII or an XMODEM file.

Select **<4> or <5>** from the SAVE/RESTORE TRACE menu and the following prompt will be displayed:

```
Download (receive) trace: Raw Data format.
Start Transfer (Y/N) ?
          or
Ready: Begin XMODEM upload protocol on your host machine . . .
```

Press **<Yes>** to confirm, then start the transfer from the host end.

Care has been taken to ignore any modem initialization characters your communications package may send out before the actual file, but it is impossible to allow for every possibility. If you repeatedly get the message "Unrecognized format" when attempting downloads, disconnect the null-modem cable until the next keystroke at the host-end will initiate.

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Note again, that only the 'Raw Data format' file or the XMODEM format can be reloaded into the Ultra-2000. Any other file format will result in the "Unrecognized format" message.

See Appendix H for an example of using the PC and the ProComm PLUS communication package for restoring the trace from a PC host.

2.3.4 <6> or <7> - RESTORE TRACE FROM HOST VIA PARALLEL PORT

A trace saved to a file in 'Raw Data' format can be loaded back into the Ultra-2000 trace memory for more study. This function is analogous to saving the trace, as described in Section 2.3.2, except that the direction of transfer is different. See Appendix G.

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SECTION 3

DISPLAYING THE TRACE MEMORY

3.1 INTRODUCTION

The Ultra-2000 has several display formats for the data captured by tracing. Each format has its own characteristics and special capabilities to let you view the events recorded. See appendix E for a discussion of the SCSI-3 SCAM protocol and its display on the Ultra-2000.

When you select the **<Display>** option from the main menu, a message will appear showing which format of display is currently selected, and prompting for a starting address. You may select a different display format at this point; just press the **<No>** on the built-in keypad, or **<N>** from an external keyboard. The Display Format menu will appear, as described in section 3.7.

To start the display, select a starting (and optionally an ending) address in any of the formats which follow. Addresses must be in hexadecimal in the range 0-1FFFF (0-7FFFF if you have the optional 512K deep trace). The address must also be within the recorded range i.e. less than the address at which recording stopped, as reported when you pressed **<Stop>**, or the trigger occurred. If you type an address out of range, it will be rejected and you will be given another opportunity to select an address.

1) Press **<Enter>** with no numeric entry to start displaying at the start of trace memory, with a pause at the end of each page displayed.

2) Type an address and press **<Enter>** to display one page beginning at the address typed.

3) Type two addresses separated by a hyphen (-) and press **<Enter>** to display the entire range of events between and including the two addresses. This is the option you may want to select if you are printing a trace in hard copy through the parallel port, and you need to print more than one screen.

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4) Type an address followed by a hyphen (-) and press **<Enter>** to display all events from the address typed to the end of trace.
5) Type a hyphen (-) followed by an address and press **<Enter>** to display all events from the start of trace up to and including the address typed.

6) Type just a hyphen (-) and press **<Enter>** to display the entire recorded trace.

Displaying within a range longer than one screen length would usually be selected when also generating hard copy on a printer. Use **<Ctrl-^Print>** key on the keypad or **<^P>** on the external keyboard to toggle the printer **ON** and **OFF**.

After the initial display, the Ultra-2000 will pause for more input from you. At that time, you can access the Search functions (see section 5), the Time difference calculator (see section 2.2.13), the Trigger (section 4), the Trace-Mode (section 2.2.5) or Utilities (section 7) menus. You can also continue displaying with the following options.

1) Press **<Next>** from the keypad, **<Space>** or **<PgDn>** key from the keyboard to display the next full page of trace memory in the current format.

2) Press **<Prev>** from the keypad or **<->** from the keyboard to display the previous page of trace memory in the current format. The **<PgUp>** key also accomplishes this action. Note that in the structured format, because of the unpredictability of the number of events making up one page of display, moving backward may not always go exactly one page so the display may scroll to reach the correct place for the start of page. However, in the other formats, page length is determinate and moving backward goes exactly one page at a time.

3) Press a number from **<1>** to **<9>** to display that many more lines forward in the current display format. This series of lines becomes the entire new page, although the full 25 lines will appear on the screen.

4) Press **<Home>** to display one page starting at the beginning of trace.

5) Press **<End>** to display (about) a page starting about half page before end of trace.

6) **<A>** allows entry of a starting address for the next page to be displayed.

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7) Press the **<16-8 bit>** key on the keypad, or the **<W>** key on the external keyboard, to flip between wide (16-bit) and narrow (8-bit) data display. Note that wide data can only occur during a Data-In or Data-Out phase, and only that part of the display is affected. When displaying wide data, the low byte appears first, separated by a hyphen from the high byte. The separator character may be an asterisk (*) if a parity error occurs or a plus-sign (+) if the ATN line is active.

8) Press the **<Alph-Hx>** key on the keypad or the **<H>** key on the external keyboard to flip between ASCII representation and hexadecimal display of data bytes. This will affect only the Structured display. When displaying data in ASCII format, unprintable characters will appear as periods (.).

9) Press the **<Flip>** key on the keypad or the **<F>** key on the external keyboard to toggle between the Structured and Binary display formats. The page displayed will start at the same address as did the one being replaced.

10) Press **<C>** (or **<Alt-C>** on the keypad) to 'flip' to the Compact Display format. The trace display will start at the same address as the page being replaced.

11) Press **<D>** (or **<Display>** on the keypad) to 'flip' to the Hex Dump display format. The trace display will start at the same address as the page being replaced.

12) Press **<P>** (or **<Pause>** on the keypad) to 'flip' to the Command profile display format. The trace display will start at the same address as the page being replaced.

13) In the Binary format, press **<^TmFmt>** key on the keypad or **<E>** on the external keyboard to switch between total elapsed time (since start of tracing) and differential time (between successive events). In the Structured format, this key enables/disables the display of timing information.

14) While displaying in Structured format, press **<E>** (or **<Alt-E>** on the keypad) to add the time stamp on the right margin of the screen. In Structured display this always indicates time differential.

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3.2 THE STRUCTURED DISPLAY FORMAT

This format is the easiest to read and interpret. Each line of display starts with the trace memory address of the first event of the line. Each SCSI phase is labeled with its name. In addition, the first byte of the Command Descriptor Block (CDB) is interpreted, as are each Message byte and Status byte. Phases are indented as with program structure. The Reset condition and Bus Free phases are aligned with the left edge of the display after the address. Arbitration, Selection and Reselection phases are indented one tab stop, 3 spaces. Command, Status, Message-In and Message-Out phases are indented a further tab stop, 6 spaces. Data-In, Data-Out and the two Reserved phases are indented another tab stop, 9 spaces.

The actual data transferred, as well as the ID numbers during Arbitration, Selection and Reselection, are shown in Hex, following a slash. If a **parity error** occurs at any time (except in arbitration phase), an **asterisk** will follow directly after the offending byte. If no parity error occurred, but the SCSI **ATN line** is active, that is shown as a **plus-sign** following the byte. **Data count**, i.e. number of transfers during the Data-In or Data-Out phase is shown in Hex format and in parentheses just after the trace memory address for the last line of the data phase.

NOTE:
There are situations when the tested system hangs during the data phase, and you need to find out how many data bytes were actually transferred. Normally, when the system hangs, you press **<Stop>** or **<S>** to stop the tracing, then **<Esc>** to exit to main menu, and **<D>** to display the trace. You will not see the data count (in parentheses) at the end of the last (hung) data phase on the structured display. This is because the data count is recorded in the trace memory when Bus Free phase is entered. (Ultra-2000 stores data count in the data byte memory of the Bus Free event. This recording is all done by Hardware because of the recording speed requirement). If you need to see the data count, press the SCSI RESET pushbutton to reset the Target before you press **<Stop>**, and this will result in Bus Free phase, and subsequent recording of the data count in the trace memory.

To avoid clutter, multi-byte messages have the phase label only on the first byte. Multi-line data phases similarly are labeled only on the first line.

When enabled, the duration of each phase is displayed on the last line of that phase (if space is available on the line). Press **<^TmFmt>** to toggle between timing display enabled/disabled (press **<E>** on the external keyboard).

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Several samples of Structured displays, showing the various recording and display modes, follow.

3.2.1 Structured Display with NARROW or WIDE data transfers

The example display below shows the data in ASCII format. Recording captured all data. This recording was made with 'capture 4 edges REQ/ACK' mode turned OFF. Note that in line 4 the IDs of the SCSI devices involved are shown both as the bits set on the SCSI bus, and as the decimal equivalent ID numbers of the two devices. Also note, that during the first Message-Out phase, the Initiator held ATN active, as shown by the (+) following each message byte. This trace shows a typical boot sequence for a host adapter card at ID 7 finding out about the Target device at ID 0.

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```
00000: ---- Start Trace ----
00001:   Arbitration     /80 (7)
00004:   Select w/ATN    /81 (0,7)
00007:      Message-Out  /C0+(Identify : LUN 0 Disconnect OK)
00008:      Message-Out  /01+(Ext Msg)
00009:                    03+(Length)
0000A:                    01+(SDTR)
0000B:                    28+(Period 160 nsec)
0000C:                    08 (Offset 8 bytes)
0000D:      Message-In   /01(Ext Msg)
0000E:                         03 (Length)
0000F:                    01 (SDTR)
00010:                    32 (Period 200 nsec)
00011:                    08 (Offset 8 bytes)
00012:      Command      /12 00 00 00 30 00 (Inquiry)
00018:           Data-In      / .  .  .  .  .  .  .  .  A N C O T
00028:                    D S C  -  3 0 2  /  J
00038: (0024)             3 . 4 0
0003C:      Status       /00 (Good)
0003D:      Message-In   /00 (Cmd Cmplt)
0003E: Bus Free
0003F:   Arbitration     /80 (7)
00042:    Select w/ATN   /81 (0,7)
00045:       Message-Out /C0+(Identify : LUN 0 Disconnect OK)
00046:       Message-Out /01+(Ext Msg)
00047:                         03+(Length)
00048:                         01+(SDTR)
00049:                         28+(Period 160 nsec)
0004A:                         08 (Offset 8 bytes)
0004B:       Message-In  /01 (Ext Msg)
0004C:                         03 (Length)
0004D:                         01 (SDTR)
0004E:                         32 (Period 200 nsec)
0004F:                         08 (Offset 8 bytes)
00050:       Command     /03 00 00 00 10 00 (Req Sense)
00056: (0008)   Data-In  / p  .  .  .  .  .  .  .
0005E:      Status       /00 (Good)
0005F:      Message-In   /00 (Cmd Cmplt)
00060: Bus Free
00061:   Arbitration     /80 (7)
00064:   Select w/ATN    /81 (0,7)
00067:      Message-Out  /C0 (Identify : LUN 0 Disconnect OK)
00068:      Command      /00 00 00 00 00 00 (Test U Rdy)
0006E:      Status       /00 (Good)
0006F:      Message-In   /00 (Cmd Cmplt)
00070: Bus Free
00071:   Arbitration     /80 (7)
00074:   Select w/ATN    /81 (0,7)
00077:       Message-Out /C0 (Identify : LUN 0 Disconnect OK)
00078:       Command     /25 00 00 00 00 00 00 00 00 00 (Rd Cap)
00082: (0008)   Data-In  / .  .  .  .  .  .  .  .
0008A:      Status       /00 (Good)
0008B:      Message-In   /00 (Cmd Cmplt)
0008C: Bus Free
0008D: ---- End of Trace ----
```


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Press **<E>** to enable / disable display of the time stamp on the right margin. The format is the same as in the binary display, and it gives / specifies time for that certain phase. The time stamp will not be displayed if there is no room on the right side of the screen, like with the data phase. To show time for the data phase, the byte count has to be short enough, e.g. by using recording mode with "skip data after 8 bytes" option.

```
00060: Bus Free                                                  354 934 680
00061:    Arbitration      /80 (7)                                     3 560
00064:    Select w/ATN     /81 (0,7)                                 833 600
00067:       Message-Out   /C0 (Identify : LUN 0 Disconnect OK)      589 920
00068:       Command       /00 00 00 00 00 00 (Test U Rdy)         2 061 040
0006E:       Status        /00 (Good)                              1 061 720
0006F:       Message-In    /00 (Cmd Cmplt)                           663 920
00070: Bus Free                                                    3 415 120
```

When viewing WIDE data transfers, press the **<16-8bit>** or **<W>** key on the keypad or keyboard respectively to toggle this display option. The WIDE data in the data-in/out phase will be shown as two bytes (the low byte first) separated by a hyphen. If the recording was made on a NARROW system, the upper byte (not driven) will be marked by an asterisk, indicating parity error.

```
00187: Bus Free
00188:         Arbitration     /01 (0)
0018A:         Reselection     /81 (0,7)
0018D:            Message-In   /80 (Identify : LUN 0)
00191:D              Data-In   /DE-E7 D4-D8 FD-FF DE-80 FD-D7 33-AD CF-77
D8-39
001D1: (0200)                  BA-6F 76-77 FE-7D B9-1E C3-F7 EF-E6 D7-8A EA-EC
0020F:            Status       /00 (Good)
00213:            Message-In   /00 (Cmd Cmplt)
00217: Bus Free
```

3.2.2 Structured Display with NARROW data transfers

This display is shown here with data in Hex. Recording was done in Skip-Data (32 transfers) mode, with '*capture 4 edges REQ/ACK*' mode turned ON. Note the byte count (in parentheses, in Hex format) on the last line of the data phase for each transfer.

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```
00000: ---- Start Trace ----
00001:    Arbitration       /80 (7)
00004:       Select w/ATN   /81 (0,7)
00008:       Message-Out    /C0 (Identify : LUN 0 Disconnect OK)
0000C:       Command        /08 00 00 00 01 00 (Read/Rcv)
00023:       Message-In     /04 (Disconnect)
00027: Bus Free
00028:    Arbitration       /01 (0)
0002A:    Reselection       /81 (0,7)
0002D:       Message-In     /80 (Identify : LUN 0)
00031:          Data-In     /00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00071: (0200)  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000AF:       Status         /00 (Good)
000B3:       Message-In     /00 (Cmd Cmplt)
000B7: Bus Free
000B8:    Arbitration       /80 (7)
000BB:    Select w/ATN      /81 (0,7)
000BF:       Message-Out    /C0 (Identify : LUN 0 Disconnect OK)
000C3:       Command        /08 00 00 22 01 00 (Read/Rcv)
000DA:          Data-In     /FF FF FF F7 FF FF 7F 15 FE FF FF FF FF FF F7 6F
0011A: (0200)                FF FF FF FF FF FF FF FF BB FF FF FF FF FF FF 9F
00158:       Status         /00 (Good)
0015C:       Message-In     /00 (Cmd Cmplt)
00160: Bus Free
00161:    Arbitration       /80 (7)
00164:    Select w/ATN      /81 (0,7)
00169:       Message-Out    /C0 (Identify : LUN 0 Disconnect OK)
0016C:    Command           /08 00 00 5C 22 00 (Read/Rcv)
00183:       Message-In     /04 (Disconnect)
00187: Bus Free
00188:    Arbitration       /01 (0)
0018A:    Reselection       /81 (0,7)
0018D:       Message-In     /80 (Identify : LUN 0)
00191:          Data-In     /DE E7 D4 D8 FD FF DE 80 FD D7 33 AD CF 77 D8 39
001D1: (4400)                BA 6F 76 77 FE 7D B9 1E C3 F7 EF E6 D7 8A EA EC
0020F:       Status         /00 (Good)
00213:    Message-In        /00 (Cmd Cmplt)
00217: Bus Free
00218: ---- End of Trace ----
```

3.2.3 Structured Display of SCAM Protocol

In the structured display, you will see the SCAM Protocol in plain English. A sample is shown below. During the Isolation phase, it is assumed that the identification string (after the 'type' code bytes) is printable ASCII, and is

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displayed that way. For the 'type' code, and for any non-printable character, the value is displayed in Hexadecimal between angle brackets **<xx>**.

Function codes are displayed both in Hexadecimal and in English. The Isolation phase is labeled as either 'Terminated' or 'Complete'. Command codes are given in English. In all cases, if an illegal handshake occurs, it is labeled as such. One example is at the end of the SCAM process, when the Master releases C/D.

```
00000: ---- Start Trace ----
00001: RESET Start
00002: RESET End
00002: Bus Free
00004:    Arbitration   /(no ID)
00005:    SCAM Selection
0000B:      SCAM Function : 1F Synch Pattern
00011:      SCAM Function : 00 Assign ID
00017:          Name : <12><00> ANCOT   SCAM Test 00001 (Complete)
000F8:             Assign ID 00
000FE:      SCAM Function : Invalid handshake
00102: Bus Free
00103: ---- End of Trace ---
```

Note that in order to analyze the SCAM Protocol, the trace needs to be recorded in the 'Capture SCAM Protocol' mode first. See sections 2.2.5 and 2.2.5.7 for more.

3.3 THE BINARY DISPLAY FORMAT

If the Structured display format is compared to a computer program written in a high-level language, the Binary display format is like the same program written in assembly language. In the Binary format, each event captured gets one line of display. In this display format, you can see the exact state of each SCSI control line at the time of the event's capture, plus the state of the SCSI data lines and the ANCOT expansion lines. Furthermore, the timing of the activity is shown, accurate to the 7.5-ns resolution of the Ultra-2000.

There are several options in how the information is presented in the Binary format.

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First, the control lines can be shown in logic analyzer style, as a rectangular waveform traveling down the page. In this format, an active signal is shown as a thin line on the right side of the area dedicated to that control line. Inactive signals show as thick lines on the left side of their respective areas.

Data can be shown as **wide** or **narrow.** If the wide data format is chosen, then the low byte is shown first, separated from the high byte by a hyphen (-). If a **parity error** occurred, that is shown by an **asterisk (*)** following the offending byte. The asterisk (*) may replace the hyphen (-) separating the two bytes. The bytes are shown in hexadecimal first, followed by their ASCII equivalent in parentheses.

Each line of display also shows the state of the three signals received through the expansion connector J2 (DB-15) marked as **'Exp'** in the examples below. E2 is the most significant bit, shown on the left of the triad. It is followed by E1 and then E0.

Time stamp information comes in either of two formats also. In the [Total] format, the total **elapsed** time since the start of the recording (modulo about 170 seconds) is shown in the time column. In the [Diff] format, the time **differential** between the two events is shown in the time column. All times are expressed as decimal nanoseconds, with a space between each group of three digits. As an example, the "3 123 456 789" represents 3sec 123ms 456μs 789ns.

Each line of display shows whether the **data** byte on that line is **valid.** If it is valid, then the address (on the left) is followed by a right angle **bracket (>).** If not, the address is followed by a **colon (:)**.

The various display options are shown in the following sample displays. This first display example shows the logic analyzer style of control signals, with 8-bit data and differential time display. This trace also shows 'capture 4 edges REQ/ACK' and 'capture-all-data' mode of recording. Note that the data word at the Bus Free event after the command, holds the data count (0008 bytes) in the data-in phase of this command. Just to the right of the Exp column, during the data phase only, the current **REQ/ACK offset** is shown as a 2-digit hexadecimal number. This number is valid only if the display started

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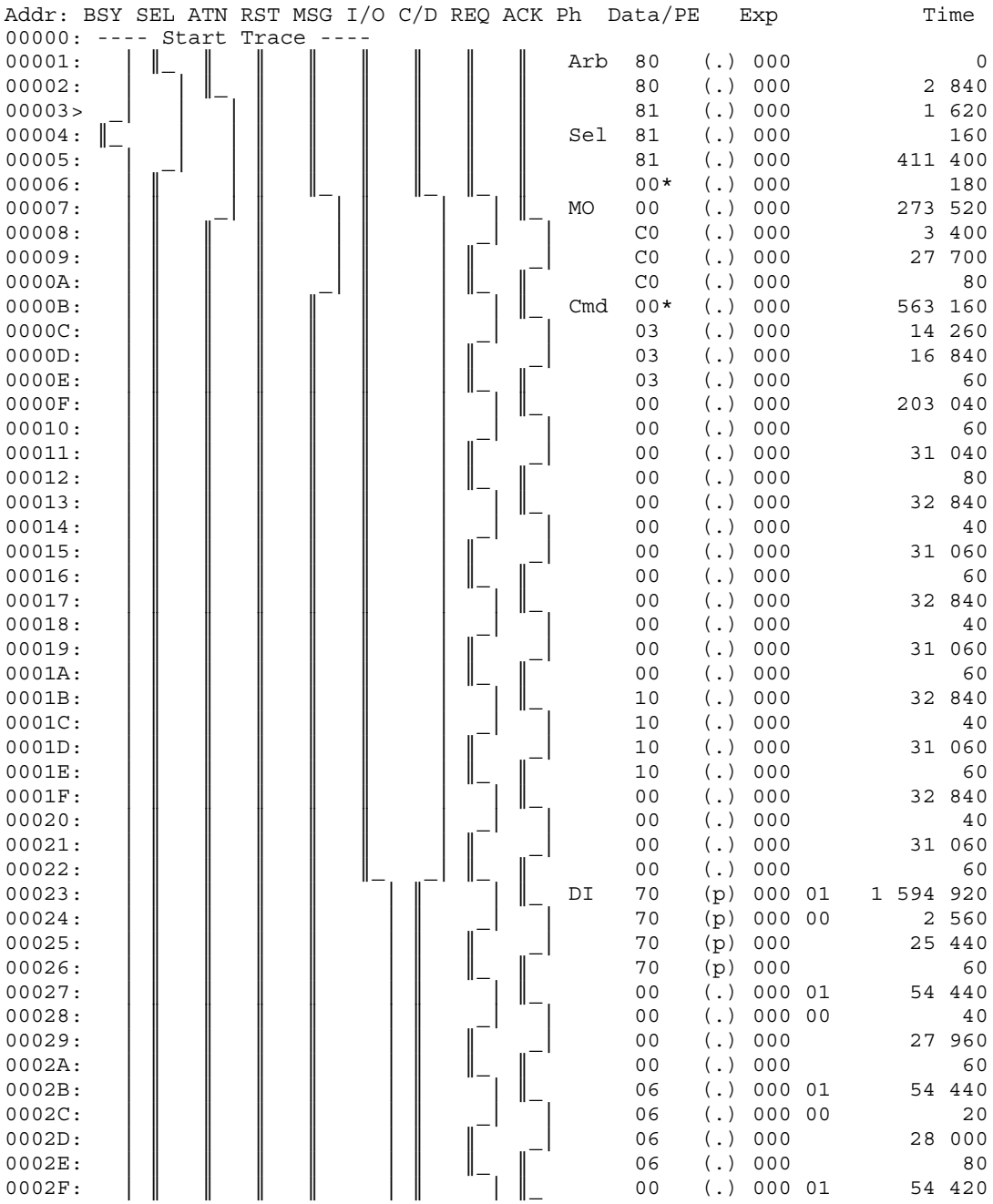
at (or before) the start of the data phase, and "save all/skip data [all]" is selected from the Mode menu. The number is generated from the recording of the REQ and ACK signals in the data phase; if the recording mode does not include 4-edge capture, or if Skip-Data is enabled, the offset is not shown.



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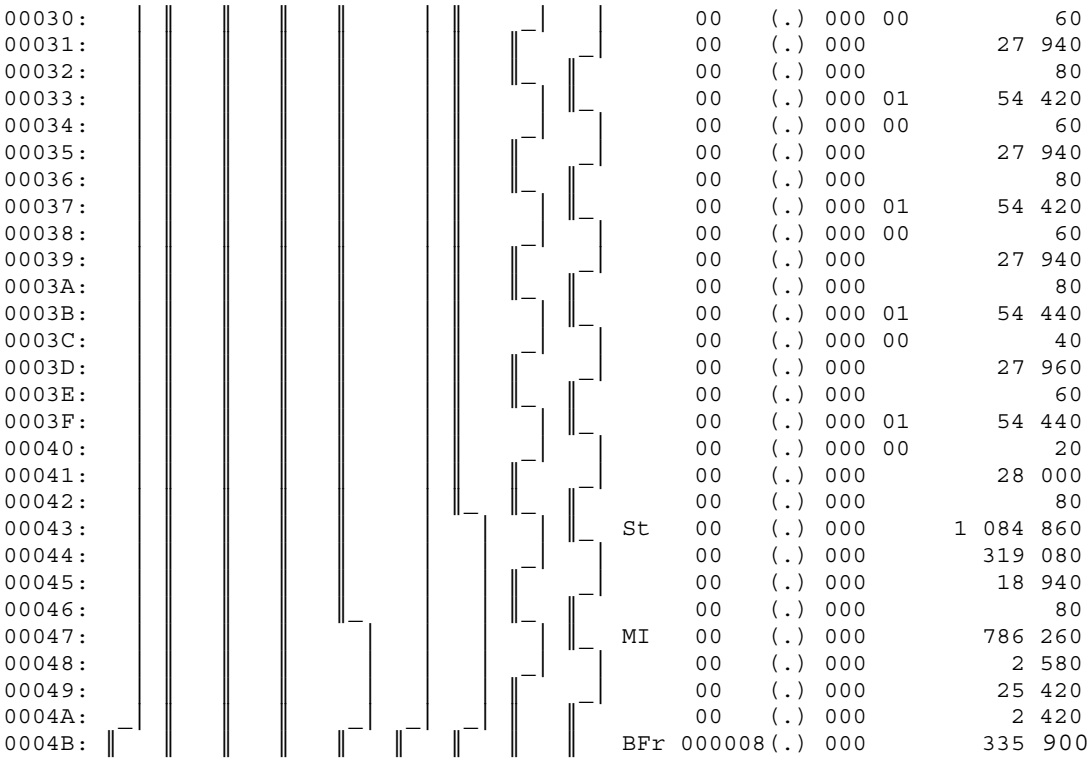
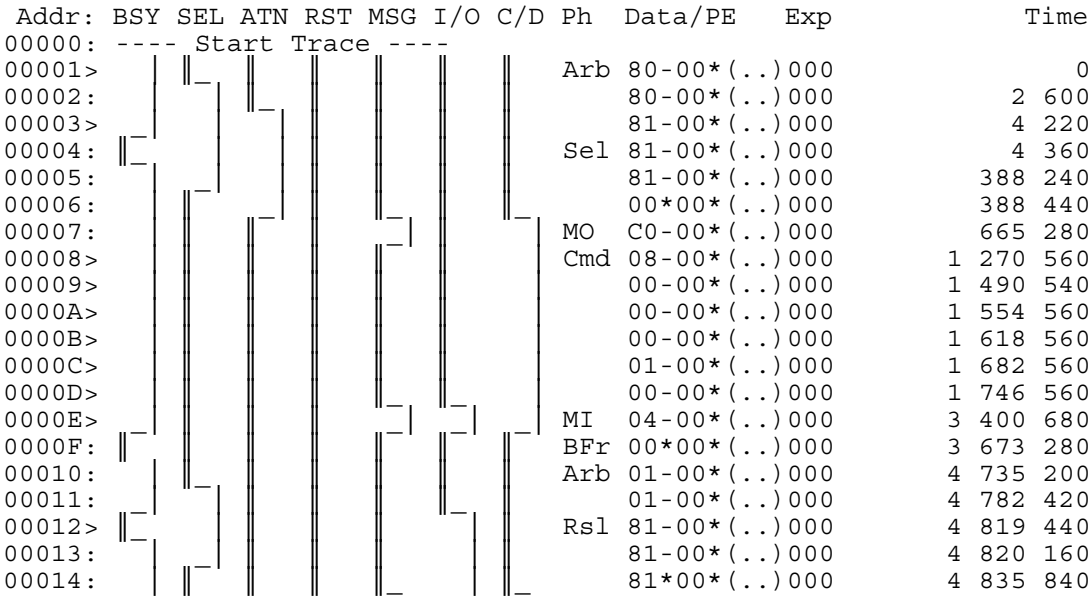


The following display example shows the same style display except with 'Wide' data (16 bits + parity) and total elapsed time display. This trace also shows the single-edge REQ/ACK mode of recording (REQ and ACK not shown) and skip data (after 8 events). Note also the presence of the trigger event, marked with a 'T' next to the 00015 address.



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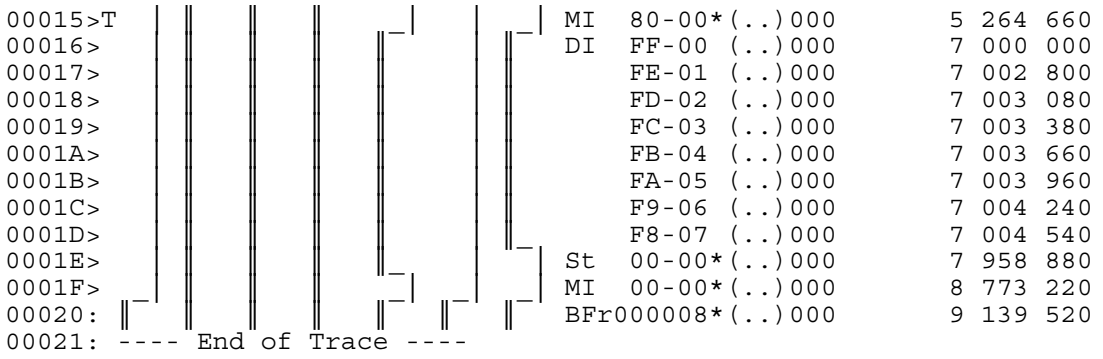
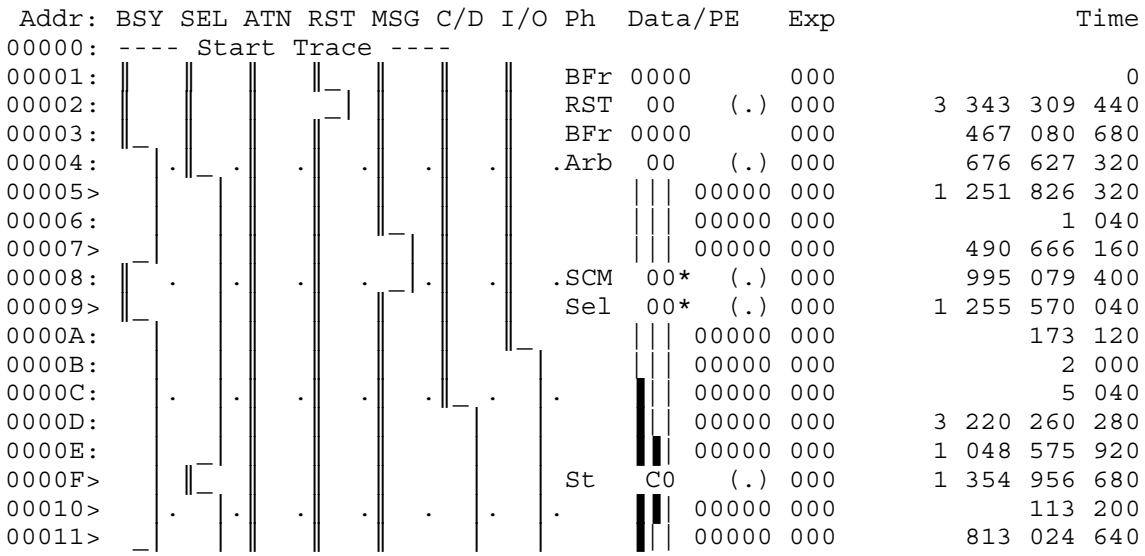


3.3.1 Binary display of SCAM Protocol

In the binary display format, you will see the SCAM data handshake near the horizontal middle of the screen. The SCAM data and handshake take the place of the normal display of data in Hexadecimal and ASCII. Only the SCAM Selection is interpreted in the Phase column (between the SCSI control lines and the data). It is shown as SCM.

The handshake is shown as thick (active) or thin (inactive) lines for D7, D6 and D5 (left to right). The data is shown in binary from D4 to D0 (left to right). The event with valid data is shown with a square bullet between the handshake and the data. An example is shown below.

Note the short duration event at address 18. It seems that this is a spurious capture, since no change is evident from the preceding event. This is the "wired-or glitch" which must be filtered out by the software or hardware executing the protocol.



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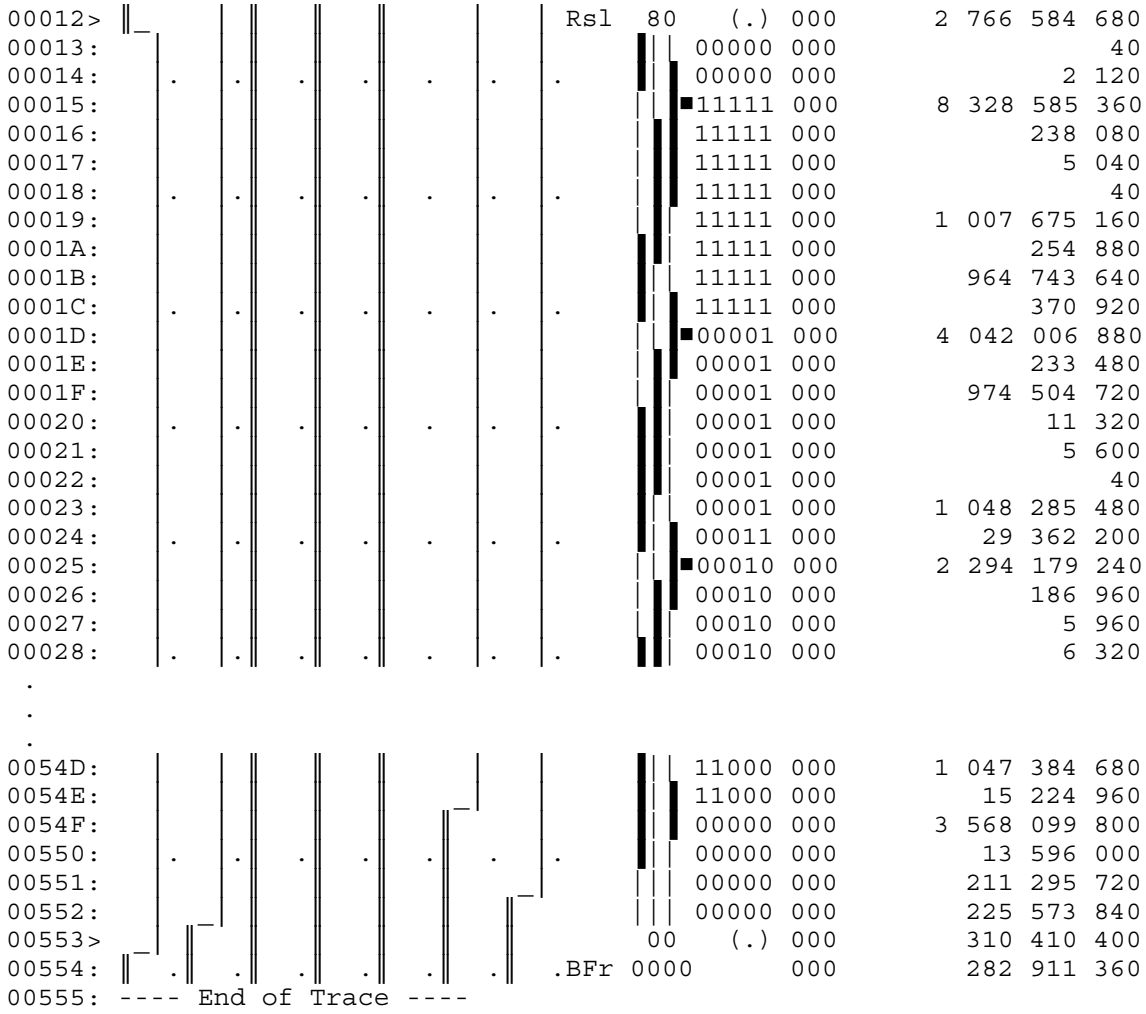

Note that in order to analyze the SCAM Protocol, the trace needs to be recorded in the 'Capture SCAM Protocol' mode first. See sections 2.2.5 and 2.2.5.7 for more.

3.4 THE HEX DUMP FORMAT

The Hex display format is very compact but also hard to read. It is intended only for the most intractable problems. Each line of output shows the starting address plus the contents of trace memory for that address and for the following two addresses, each separated by slash.

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The format of each event is : four characters of control bits, a space, another two characters of control bits, a space, four characters of data bits, a space, and eight characters of time stamp bits.
The first sixteen control bits are in the order: [ATN, ATN, ATN, ATN], [TRG, E2, E1, E0], [PEH, PEL, BSY, SEL], [RST, MSG, C/D, I/O]. The "res" in this text stands for "reserved". The second group of control bits are: [ACK0, ACK1, ACK2, ACK3], [REQ0, REQ1, REQ2, REQ3]. The data bits are MSB (d15) to LSB (d0). The time stamp bits are in their raw form : the number of ticks (each 30 nanoseconds long) since the recording started.

```
00000:  0811 00 0000 75562E28 / 0801 00 0000 7556D1D1 / 0880 00 0080 755AD9BC
00003:  08C0 00 0080 755ADA3E / 48E0 00 0081 755ADA8F / 0860 00 0081 755ADA97
00006:  08E0 00 0081 7571905C / 08A1 00 0000 75719065 / 188A 00 00C0 7571C673
00009:  7882 00 0000 75723CA7 / 7882 0F 0000 757267A8 / 7882 C0 0000 75727428
0000C:  7882 00 0000 757280A8 / 7882 00 0000 75728D28 / 7882 00 0000 757299A8
0000F:  5886 00 0002 7573977C / 588E 00 0000 75743530 / 0801 00 0000 75747CBB
00012:  0880 FE 0080 7578C115 / 08C0 FE 0080 7578C198 / 48E0 00 0081 7578C1E8
Addr:   Ctrl AR Data Time       Ctrl AR Data Time       Ctrl AR Data Time
```

3.5 THE COMPACT DISPLAY FORMAT

The compact display format is a condensed version, which can be used for viewing the captured SCSI activity with up to 24 commands per screen. See section 3.7 for instructions on how to select this display format. Each recorded SCSI connection (from Bus Free to Bus Free) occupies only one line of display. You can use this format for previewing a certain area of trace memory, then switch to the Structured Display format or the Binary Display format to see it in more detail.

The information presented includes :

- Trace Memory Address of Start of Connection
- SCSI ID of Initiator and Target and direction of connection (i.e. Selection vs Reselection)
- Command (CDB) transmitted
- Number of bytes of data transferred and the direction (In or Out)
- SCSI Status transmitted
- Final Message of connection
- Elapsed time of connection

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Note that not all connections have all these types of information. Those which do not apply are left blank.

```
00000: ---- Start Trace ----
00001:  7->0 Req Sense       000012   I   Good      Cmd Cmplt           5 297 400
0002F:  7->0 Test U Rdy                  Good      Cmd Cmplt           1 406 200
00041:  7->0 Read/Rcv                              Disconnect            819 720
00052:  7<-0                  000200 I   Good      Cmd Cmplt           2 464 400
        ...
00B0C:  7->0 Write/Send      000200 0    Disconnect                    2 335 000
00D1E:  7<-0                           Good         Cmd Cmplt        946480
       ...
07FFF:    ---- End of Trace ----
```

3.6 THE COMMAND PROFILE FORMAT

This format gives a graphical representation of the proportion of time spent in each phase. See section 3.7 for instructions on how to select this display format. One full command is displayed on each screen, including disconnect(s), reselection(s), all information transfer phases, etc. The heading of the display shows the trace memory address range occupied by the command, the SCSI IDs of the Initiator and Target, and the opcode and interpretation of the command transmitted. This format assumes that each command is contiguous in the trace. If commands are interleaved, the resulting display is unpredictable.

The Command Total time is shown at the bottom of the screen. If one or more disconnects were involved in this command, then the Command Total will be shown as two values: first the time with disconnect included, followed by the time with disconnect excluded.

The disconnect itself is shown on the line above the Command Total, both in raw time (in nanoseconds) and as a percentage of total command time (including disconnects).

Each bar displayed also shows timing information, both in raw time (in nanoseconds) and as a percentage of the total (excluding disconnects) command time.

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```
        SCSI COMMAND PROFILE

 Trace Address     :  00040 - 0025B
 IDs               :  I7 -> T0
 Command Code      :  08 Read/Rcv
 Data Transferred  :  512 Bytes

 Arb/Sel:           71 600 ns        3.7%
 ID Msg:            93 920 ns        4.9%
 Command:          300 560 ns       15.9%
 Data:             735 600 ns       38.9%
 Status:           286 360 ns       15.1%
 End Msg:          398 480 ns       21.1%
                  ___________
 Cmd Total:      1 886 520 ns
```

The following definitions of phases are used in calculating the timing:

Arb/Sel : from the assertion of BSY to the first event in Message-Out (for the Identify message).

ID Msg : from the start of Message-Out phase to the first event w which is neither Message-Out nor Message-In phase.

Command : from the first event in the Command phase to the first event not in Command phase.

Data : from the first event of either Data-In or Data-Out phase to the first event after the last event in the same phase, after subtracting any disconnect time.

Status : from the first event in Status phase to the first event not in Status phase.

End Msg : from the first event in the last Message-In phase of this command to the release of BSY (Bus Free).

Disconnect : from start of Message-In phase for any disconnect message to the end of Message-In phase for the Identify message after reconnect. All such periods within this command are added together.

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Command Total : from the assertion of BSY just before the Selection phase to the release of BSY after the Status phase. The time not including disconnect time is also shown for commands which involved a disconnect.

3.7 CHANGING THE DISPLAY FORMAT

The display format can be changed using the TRACE MEMORY DISPLAY FORMAT MENU. Access this menu from the main menu by pressing the **<Alt-4>** key on the keypad, or the **<F>** key (for "format") on the external keyboard. You can also access this menu after pressing **<Display>**, then at the prompt for the display starting address, press **<No>** on the keypad, or **<N>** on the external keyboard.

When in the TRACE MEMORY DISPLAY FORMAT MENU, use the up or down arrow keys to select an item to be changed, then use left or right arrow keys to change it. In a case of multiple choices, the left or right arrow keys will change the value by +1 or -1 respectively.

```
TRACE MEMORY DISPLAY FORMAT: [Structured]
_________________________________________

<0> - [24] Lines per page
<1> - Structured Display
<2> - Binary Display
<3> - Hex Dump Display
<4> - Compact Display
<5> - Command Profile

Your selection (0../Quit) ?
```

<0> - Lines per page - controls the number of lines of display that will be printed between keypresses. The default number of lines is 24 decimal. If you change this value, your selection is saved in EEPROM to become the default next time you turn the Ultra-2000 on. If you select value = 0, then display will run from the current line to the very end of the trace; this may be useful if you need to print the entire trace out (using the ^P option).

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<1> - Structured Display - causes the next page of trace to be presented in Structured format.

<2> - Binary Display - causes the next page of trace to be presented in Binary format.

<3> - Hex Dump Display - causes the next page of trace to be presented in Hex Dump format.

<4> - Compact Display - causes the next page of trace to be presented in a Compact format, showing one SCSI command per line.

<5> - Command Profile - causes the next page of trace to display a timing analysis of a single SCSI command by phase.

See also section 3.1 for other display options.

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SECTION 4

SEARCHING FOR EVENTS IN THE RECORDED TRACE

4.1 INTRODUCTION

The Ultra-2000 provides a powerful, easy-to-use searching utility. This feature provides you with the ability to 'home in' on the event of interest in your recorded trace, without needing to wade through the uninteresting events either before or after. You can specify the exact combination of phase and data pattern you are interested in. If the event exists in the trace, the corresponding part of trace memory will be displayed, and the found event line will be marked by '>>>>>>'. If the certain event is not found, the current display page will be shown again with "NOT FOUND" message in the lower right corner of the screen.

When you select FIND, from the main menu or from a display, the following menu is displayed:

```
      FIND SCSI EVENT MENU
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
Bus Free Phase          Command Phase
Attention Condition     Status Phase
Parity error            Message-In Phase
Arbitration Phase       Message-Out Phase
Selection Phase         Data-In Phase
Reselection Phase       Data-Out Phase
SCSI Reset Condition    Reserved Phase (In)
Trigger Condition       Reserved Phase (Out)
<X> - Trace PAUSE       Data only (ignore phase)
                        <Z> - Custom Control Bit Pattern
                                 xxxx   xxxx  00x0  xxxx
Your selection (0../Quit) ?
```

Use the arrow keys and move the bar to the event or phase you want. For a single-key selection, press the selector letter (underlined on the screen) on the external keyboard. Then press **<Enter>,** and the following options menu is displayed:

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```
SEARCH OPTIONS MENU
••••••••••••••••••••••••••          Command Phase
Data Bits Pattern                ••••••••••••••••••••••••••
Wide data pattern [ ]            1 : xxxx xxxx   XX
Forward/Backward  [F]            2 : xxxx xxxx   XX
Occurrence        [ 1]           3 : xxxx xxxx   XX
Addr Range [      ]-[      ]     4 : xxxx xxxx   XX
Start Addr [      ]              5 : etc
```

If the phase/event you selected allows a data pattern, the cursor will be placed in the right side, to edit the pattern. Otherwise, the data pattern will be ignored. The top line, as the 'Command Phase' in the example above, indicates the selected phase to be used.

4.1.1 SELECT A CUSTOM CONTROL BIT PATTERN

Most of the patterns are self-explanatory, but a few need additional comments. Notice as you move the bar through the phase selections that the bit pattern, shown below the "Custom Control Bit Pattern", changes to match the trace event.

<N> - Attention condition. This event is matched when BSY and ATN are both active, and RST is inactive. This commonly occurs during Selection, and during extended messages, as well as when the Initiator needs to send a message to the Target.

<P> - Parity error. This event is matched when BSY is active, data are valid (qualified by REQ/ACK for data In/Out, and during Selection and Reselection), and parity is EVEN (the parity error bit is set) for the low byte of SCSI data. If wide data pattern is enabled, the parity error bit for the high byte of SCSI data is also examined.

<T> - Trigger condition. There is at most one matching event in any recorded trace. The direction flag is ignored in searching for this event. The search automatically proceeds in the correct direction.

<X> - Trace PAUSE. Each time recording is paused, an artificial event (PAUSE marker) is written into the trace memory.

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<D> - Data only (ignore phase). This pattern ignores the state of the control lines MSG, C/D and I/O. However, BSY will be active, SEL and RST will be inactive, and the data transfer will be qualified by REQ/ACK for transfers In/Out. The data pattern specified can even span more than one phase.

<V> - Reserved Phase (In)
<U> - Reserved Phase (Out). The ANSI SCSI specification leaves undefined (reserved for future standardization) two of the eight possible configurations of information transfer phases. These patterns are matched when MSG is active and C/D is inactive, and the state of I/O matches the (In) or (Out). Data will also be qualified by REQ/ACK for transfers In/Out.

<Z> - Custom Control Bit Pattern. Use this selection if none of the patterns matches the event phase you want to find. When you press **<Enter>** with the bar on the **<Z>** item, the following screen will be displayed:

res	res	res	ATN	TRG	E2	E1	E0	PEH	PEL	BSY	SEL	RST	MSG	C/D	I/O
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The E0, E1, and E2 are the signals on pins 1, 2, and 3 of the Expansion connector J2, at the time of capture of this event.

You can edit individual bits of the search phase pattern using the 0, 1 and X keys, then press **<Q>** to return to the big menu. Move within the pattern using **<LeftArrow>** or **<RightArrow>** keys.

After you select the phase pattern, you will also be given the option of selecting a qualifying data pattern for that same event. The SEARCH OPTIONS menu will be displayed with cursor waiting in the first data pattern field. The default pattern is all data as 'Don't Care' starting with "1: xxxx xxxx" (binary); you may specify up to 16 bytes. Change the data pattern or simply press **<Enter>** to ignore it. The cursor will move over the "Execute find" message.

Press **<Enter>** again to execute the search.

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4.2 SELECT THE SEARCH OPTIONS

The FIND SCSI EVENT MENU gives a list of phases and conditions to search for. It also lists several options to control the search. The options are explained in detail in the paragraphs below.

- To accept the option default values: simply press **<Enter>** to execute the search. You may have to press **<Enter>** again if the event allows a data pattern.

- To change an option default value: use the arrow keys on the keypad, or the selector letter on the external keyboard, to choose the option you want to modify. Use the **<Enter>** key to toggle or increment your choice. Then press **<Enter>** to execute the search.

4.2.1 SEARCH FOR WIDE DATA PATTERN

This selection, **<W>**, will affect searches only if the Data Bits Pattern is also specified. The default value is a 'blank', indicating that wide data pattern is not chosen. When **<W>** is not enabled, only the low byte of SCSI data will be considered in the search. If the wide data pattern is enabled, both the low byte (bits 0-7) and the high byte (bits 8-15) of the captured trace will be examined for the data pattern. When using wide data, bytes are assumed to arrive low byte first. The search is smart enough that a pattern which spans two or more transfers will be found, no matter whether the first byte of the pattern is in the low or high byte of SCSI data.

4.2.2 SET THE SEARCH DIRECTION

The currently selected direction of search is shown in square brackets: [F] for forward, [B] for backward. The default is forward.
Press **<F>** to toggle between F (forward) and B (backward) search direction.

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4.2.3 SET THE OCCURRENCE COUNTER

If occurrence is set to 0 or 1, the search will find the next event matching the pattern. The default is 1. If set to any higher number n, the search will display only the nth event. After you choose **<O>** the cursor will move into the square brackets; type your selection and press **<Enter>**. The maximum value is 99.

The occurrence counting is used by the FIND function when it is executed for the first time. Any subsequent FIND-NEXT or FIND-PREVIOUS function will search for the very first occurrence of the event, ignoring the occurrence counter setting.

4.2.4 SET THE SEARCH ADDRESS LIMITS

It might take a very long time to search for a certain item if searching over the entire trace memory, especially if the trace memory is 512K events long. You may need to limit the search range.

The default limits are set to the beginning and the end of trace most recently recorded, and are shown in square brackets in the

'Addr Range [ ]-[ ]' message.

To change the address range, press **<A>** and the cursor will move to the first set of brackets showing the default low limit address. Type a new value, then press **<Enter>**. The cursor will move to the other field and you can change the ending point of the search. Press **<Enter>** again to start the search. The analyzer will automatically reorder the start and end points if necessary.

4.2.5 SET THE SEARCH STARTING ADDRESS

The starting address is initially set to the same value as the address range low limit. It is updated every time a successful search is executed. If you need to start searching from a different part of the trace memory, press **<S>**

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and type in the new starting address value. Then press **<Enter>** to start the search.

4.2.6 SET THE DATA BITS PATTERN

When searching for certain phases (like Command, Data-In/Out, etc), usually you may need to define the desired data pattern. You can specify a string up to eight bytes long. Select this option in the OPTIONS menu by pressing **<D>**. The cursor also moves to the data selections automatically if you select an appropriate phase to search for. The data bytes are displayed in both binary and hexadecimal, the default values are all 'X' ("don't cares"). This pattern is used along with Data, Command, and several other search options.

Use the **<up-arrow>** or **<down arrow>** keys to select the byte to edit. Use the **<left-arrow>** or **<right-arrow>** keys to edit within one byte. The display shows each bit of the pattern as 0,1 or x ("Don't care"). Change the bit under the cursor by typing a 0,1 or x, which replaces any value already there. To select next byte and to edit it, press the **<down-arrow>** key. If no byte is already displayed, a "don't care" byte will be created there. The length of the search pattern string will be the number of bytes displayed on the screen. For example, if you want to search for a string of four bytes, where only the first two bytes are defined, set the first two bytes, then press **<down-arrow>** key two times (to add the third and fourth bytes with "Don't Care" pattern), then press **<Enter>**. The following **<Enter>** will execute the search.

To delete an undesired byte, place the cursor on the byte and press **<Ctrl-Display>** on the keypad, or **<Ctrl-D>** on the external keyboard.

The data pattern can also be edited in hexadecimal. Press **<H>** when in the bit pattern and the cursor will move back to the parentheses at the right. Enter a hexadecimal value. To move back to the binary pattern, press **<H>** again. Pressing **<Enter>** accepts the pattern as displayed. By pressing the **<Esc>** or **<Q>** key, you can cancel your selection (of all data bytes) at any time. After all bits are set, press **<Enter>** to exit from the edit mode, and press **<Enter>** again to execute the search.

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EXAMPLE:
Searching for a READ command (6 byte CDB) at LBA=35 hex:
Press **<C>** and **<Enter>** - this will position the cursor to the data fields.
Type the first byte 00001000, **<down arrow>**, XXX00000, **<down arrow>**, 00000000, **<down arrow>**, 00110101, **<down arrow>, <down arrow>, <Enter>, <Enter>**.

This will be displayed on the screen as follows:

```
              Data-In Phase
              ─────────────
              1 : 0000 1000  08
              2 : xxx0 0000  ?0
              3 : 0000 0000  00
              4 : 0011 0101  35
              5 : xxxx  xxxx XX
              6 : xxxx  xxxx XX
```

4.3 REPEATING THE SEARCH

After a successful search, you may want to find the next event which matches the same pattern. To do this, press **<^FndNxt>** on the keypad, or **<Ctrl-L>** on the external keyboard. The search will proceed in the same direction as the previous search. You can press **<^FndPrv>** or **<Ctrl-K>** to search in the opposite direction.

The FIND-NEXT or FIND-PREVIOUS functions will always search for the first next or first previous occurrence; these functions do not use the occurrence counter.

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S E C T I O N 5

TRIGGERING

5.1 INTRODUCTION

All triggering control stems from the TRIGGER SETUP MENU. Triggering can only take place when the Ultra-2000 is tracing, as shown by a lit 'Tracing' LED on the bottom left side of the front panel. See section 2.2.2 for starting the trace.

5.2 TRIGGER SELECTIONS

Select the **<Trigger>** option from the main menu by pressing the **<Trig>** on the keypad or the **<T>** key on the external keyboard, and the following will be displayed:

```
TRIGGER SETUP MENU
──────────────────────────────────────
<0> - Trigger master Enable      [ ]
<1> - Post trigger delay [  0%] (E)
<2> -            until Bus Free ( )
<3> - Trigger on RUN (immediate)[ ]
<4> - External trigger input     [ ]
<5> - Parity error (low byte)    [ ]
<6> - Parity error (high byte)   [ ]
<7> - SCSI Reset                 [ ]
<8> - (Re)Selection Time-out     [ ]
<9> - Selection IDs    [0081]    [ ]
<A> - Reselection IDs  [0081]    [ ]
<B> - Message code       [04]    [ ]
<C> -    Command code    [12]    [ ]
<D> -    Status code     [02]    [ ]
<E> -    Combine Cmd AND Stat    [ ]
<F> -    Combine IDs AND B/C/D   [ ]

Your selection (0../Quit) ?
```

When the TRIGGER SETUP MENU appears, one entry will be highlighted with a bar of inverse video. That is the active selection. Use the **<up-arrow>** or **<down-arrow>** keys to move the highlight bar, or press the selector key, shown in < > next to the item you want to change. With the highlight bar on the item you want to change, press the **<left-arrow>** or **<right-arrow>** keys to cycle

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through the options for that item. If the item has a numerical value associated with it, shown in [ ], and you want to edit that value, first press the **<Enter>** key, then type in the new value in Hex , and press **<Enter>** key again to confirm the new selection.

When a trigger item is enabled, the letter 'E' appears in the square brackets at the right side, next to that item. When an item is disabled, the square brackets are empty.

Triggering can be completely disabled. In this case, tracing will be started or stopped only by pressing the **<Stop>** or **<S>** keys. Disable the "Trigger Master Enable" option.

Once the trigger has been selected and enabled with *'<0> Trigger Master Enable'*, press the **<Quit>** or **<Q>** keys to return to the main menu. From the Main Menu, press the **<Run>** or **<R>** keys to start tracing. The Ultra-2000 will then start recording all SCSI bus activity until the trigger condition has been met. Once the trigger condition has been met, the Ultra-2000 will continue recording until either the condition selected by item *'**<1>** Post trigger delay [nnn%]'* or *'**<2>** until Bus Free'* has been met. If *'**<2>** until Bus Free'* is selected, tracing will stop at the next Bus Free thus placing the trigger point near the end of the trace. If *'**<1>** Post trigger delay [nnn%]'* is selected, tracing will continue until the selected percentage of trace memory is filled. If 0% is selected, tracing will stop after 10 more events and the trigger will be at the end of the trace. If 100% is selected, tracing will continue until all but the 10 events before the trigger have been recorded. This will place the trigger event at the start of the trace.

The selection of *'**<2>** Post trigger delay [nnn%]'* allows you to place the trigger point anywhere in trace memory. In this manner, the desired amount of early-trigger or late-trigger delay can be selected.

Other items in the TRIGGER SETUP MENU are mostly self-explanatory. They are listed below.

<0> - Trigger Master Enable : When enabled, the selected trigger options are enabled. When disabled, no triggering will occur.

<1> - Post Trigger delay : This item specifies the amount of trace memory to use for recording following the trigger. It is specified as a percent of trace memory.

<2> - Until Bus Free : Stops tracing at the first Bus Free following the trigger event.

NOTE: item **<1>** and **<2>** are mutually exclusive and one or the other is always selected. These two selections control when recording stops following a trigger.

<3> - Trigger on RUN (immediate) : This causes tracing to begin immediately after the "RUN" pushbutton is pressed.

<4> - External trigger input : When enabled, a transition, low or high, at the external trigger connector (BNC) is a trigger condition.

<5> - Parity error, low byte : When enabled, a byte on the SCSI low data lines (D0-7, DPL) with even parity is a trigger condition. Any SCSI information transfer phase, selection or reselection phase is a candidate for this trigger. This trigger is not guaranteed for synchronous Data (In/Out) phases.

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<6> - Parity error, high byte : When enabled, a byte on the SCSI high data lines (D8-15, DPH) with even parity is a trigger condition if it occurs during a Data-In, Data-Out, or Reserved information transfer phase. Other phases are not candidates for this trigger. This trigger is not guaranteed for synchronous Data (In/Out) phases.

<7> - SCSI Reset : When enabled, a transition to the active state of the SCSI RST line is a trigger condition.

<8> - (Re)Selection Time-out : When enabled, a failed selection or reselection attempt is a trigger condition. Failed selection is defined as no response, by making BSY active, for a period of more than 250 milliseconds after the calling device drops BSY with SEL active.

<9> - Selection IDs : When enabled, the pattern of data bits on the SCSI bus during selection is matched against the pattern shown in the first set of square brackets. If match is found, it becomes the trigger condition. Note that this is different from item <F> below, where the ID pattern is considered only in conjunction with the Message, Command or Status code. Note that the pattern selected for this item is duplicated for item <A>. It is not possible to set these for different patterns. This selection will also affect ID filtering, if that recording mode is enabled (see section 2.2.5).

<A> - Reselection IDs : see **<9>** above.

<B> - Message code : When enabled, the pattern of data bits on the SCSI bus during either Message-In or Message-Out phase is compared to the pattern shown in the first set of square brackets. If it matches, it becomes a trigger condition.

<C> - Command code : see **<B>** above.

<D> - Status code : see **<B>** above.

<E> - Combine Cmd [AND] Status : Both, the matching Command code and the matching Status code must be present in the same command to cause triggering. Note that a disconnect is considered a change of command. Thus a setup requiring a Read Command code [08] and Good Status code [00] will not be detected on a command for which the target disconnects. However, Command [08] and Status [02] normally will be detected, because most such commands will not have any disconnect.

<F> - Combine IDs [AND] B/C/D : When enabled, the data pattern in **<9>** or **<A>** (Selection or Reselection IDs) MUST be present during Selection or Reselection in order for the matching of Message, Command or Status (whichever occurs first) codes to take effect. Note that this is different from items **<8>** and **<9>** above, where the ID is considered independently of the other trigger conditions enabled.

Whenever setting up trigger conditions, exercise care in your selections to avoid undesired synergistic effects between the conditions enabled. Consider carefully the event you are trying to key on, to enable properly the conditions which will trigger on that event.

5.3 TRIGGER EXAMPLES

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5.3.1 LATE TRIGGERING

The problem : Target ID 2 on the bus is sending Check Condition Status even after a Request Sense command during the power-up sequence. This prevents the boot procedure from completing, and you want to find out what the cause is.

Set the trigger conditions as follows :

```
<0> - Trigger Master Enable     [E]
<1> - Post trigger delay [50%]  ( )
<2> -           until Bus Free  (E)
<9> - Selection IDs   [0084]    [E]
<D> - Status code       [02]    [E]
<F> -   Combine IDs AND B/C/D   [E]
```

All other conditions are disabled; this is shown by empty brackets at the right edge of the Trigger Menu.

This setup will start recording when you press <Run>. SCSI events will fill space in the buffer, perhaps wrapping the circular buffer, until a command occurs involving Initiator ID=7 and Target ID=2 (as specified by the 0084 in Selection IDs); this will result in a Check Condition Status (as specified by the 02 in Status Code). Recording will continue until the next Bus Free phase, and then stops. The final event address will be displayed on the screen as the Ultra-2000 informs you that the trigger condition has been met. You can then examine the trace to see what commands preceded the Check Condition Status (=02).

5.3.2 EARLY TRIGGERING

The problem : A command results in a condition which causes your SCSI driver to crash. You think it is because of linked commands with the flag bit set.

Set the trigger conditions as follows :

```
<0> - Trigger Master Enable     [E]
<1> - Post trigger delay [ 87%] (E)
<B> - Message code         [0B] [E]
```

All other trigger conditions are disabled as shown by empty brackets at the right edge of the Trigger Menu.

This setup will start recording events as soon as you press <Run>, and will continue recording all commands until one received with a message of 'Linked-Command-Complete-with-Flag', as specified by the '0B'(hex) in Message code. At that point, having previously selected a post trigger delay of 87%, you will be able to examine commands before the 'OB'(hex) message code. Your trace looks like this:

```
┌──────────────────────────────────────────┐
│              T                           │
│                                          │
└──────────────────────────────────────────┘
│      13%    ▲            87%             │
```


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Events will be recorded until the trace memory is completely full, and then will stop to prevent overwriting the trigger event. If you press **<Stop>** before the memory fills up, that will also halt tracing. You can then examine the trace to determine what happened after the suspect event.

5.3.3 NO TRIGGER REQUIRED

The problem: occasionally the bus will hang. You want to find out the IDs involved in the transaction hanging the bus, the command causing the hang, etc.

No trigger is required for this problem. Set the '*Trigger Master Enable to [ ]*'. Start tracing by pressing **<Run>**. The Ultra-2000 will record all activity on the bus, wrapping the circular buffer each time it fills completely. When the bus hangs, press **<Stop>** to halt tracing. The message will tell you the ending address in the trace memory. This is always the maximum trace memory address if the memory wrapped. You can then examine the events just before that address to find the cause of the hanging bus.

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SECTION 6

SCSI INITIATOR EMULATION

6.1 INTRODUCTION

In many instances it is not enough to observe events passively on the SCSI bus. There are situations when you want to interact with certain devices on the bus, and you need to send SCSI commands. For this, use the SCSI Initiator emulator which gives you control over the action on the bus. The Ultra-2000/xxE Analyzer models come with the SCSI emulator built in.

Using the emulator of the Ultra-2000/xxE you can act as a SCSI Initiator. You can define the command set matching a certain type of SCSI Target, be it a disk drive, tape drive, printer, etc. You control the protocol for information transfers, deciding whether to use the narrow (8-bit) / wide (16-bit) or fast SCSI modes, or whether to act as an asynchronous/synchronous SCSI device. Using the hierarchical menu structure, you determine how each command proceeds, and control every byte of information transferred.

The current hardware version of the Ultra-2000 uses the Emulex Symbios 53C770 SCSI Protocol Controller chip which allows FAST/20 SCSI emulation. It can do asynchronous data transfers at up to 7 MHz (14 MBytes/sec if using WIDE SCSI) and up to 20MHz synchronous (40 MBytes/sec with WIDE). Connecting to the proper SCSI connector pair on the front panel, the emulator can be used on either single-ended or High Voltage Differential (HVD) bus interfaces. The Low Voltage Differential (LVD) bus interfaces can not be used in connection with the emulator, although it can be traced. When attaching the Ultra-2000 to the bus to be tested, the hardware (in the Ultra-2000) senses which interface exists, and automatically enables the proper tranceivers.

6.2 SCSI INITIATOR EMULATION

To enter the SCSI INITIATOR EMULATION MENU from the MAIN MENU, select option **"<9> - Emulate"** or press **<E>** on external keyboard. This function will allow you to issue SCSI commands one at a time or string of commands (macros) directly from this menu. You can select your commands from the upper part of the menu; you can also access several auxiliary functions of the Emulator from the lower part. The menu is as follows:

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```
                              SCSI INITIATOR MENU
_____________________________________________________________________________

SCSI COMMANDS:
A - (00) Test U Rdy     F - (12) Inquiry       K - (28) Read (10)
B - (03) Req Sense      G - (16) Reserve Unit  L - (2A) Write (10)
C - (04) Format Unit    H - (17) Release Unit  M - (3B) Write Buffer
D - (08) Read (6)       I - (1D) Send Diagn    N - (3C) Read Buffer
E - (0A) Write (6)      J - (25) Read Capacity

a - (01) Rezero         d - (1B) Start         h - (1E) Prvnt Med Rem
b - (0B) Seek (6)       e - (1B) Stop          i - (1E) Allow Med Rem
c - (2B) Seek (10)      f - (1A) Mode Sense    t-z [t]  Vendor Specific
                        g - (15) Mode Select   1-8      Exec Macro

AUXILIARY FUNCTIONS:
^X - Setup              ^E - Edit CDB          ^I - Initiator ID    [7]
^B - Build Macro  [ ]   ^H - Autofill  [AXLU]  ^T - Target ID       [0]
^L - List Macros        ^N - Link Bit    [LF]  ^U - Logical Unit LUN[0]
^D - Data Buf Mgmt      ^Y - Queue Tag[ ][  ]  ^A - LBA      [00000001]
^K - Compare Buffers    ^Z - Repeat cmd   [ ]  ^F - Incr LBA @ Wt   [ ]
^R - SCSI Reset                                ^G - Incr LBA @ Rd   [ ]

Your Selection ?
```

The SCSI COMMANDS section is self-explanatory. Remember, that format of commands, and consequently their execution may be affected by some of the auxiliary commands. Functions like **<^H>, <^N>, <^F>, <^G>** will affect the contents of the CDB sent for a command.

Execute individual SCSI commands either by typing their symbol (e.g. type **<A>** for Test-Unit-Ready,..) or move cursor over the **<A>** field then press **<Enter>**. The A through N and a through i are preprogrammed SCSI commands (saved in internal EEPROM). The t, u, v, w, x, y, and z are seven vendor specific commands; they are preset (in the EEPROM) to zeros as a default. Use **<^E>** editing function to change them. The 1 through 8 are eight macro's.

To access the individual **Vendor Specific** commands from the keypad, place the cursor on this selection and press **<Enter>**. The letter in brackets shows the current Vendor Specific command. Use the **<LeftArrow>** or **<RightArrow>** keys to cycle through the list until the desired letter is shown in the brackets, then press **<Enter>** to execute that command.

Functions **<R>, <P>, <S>**, and **<Q>** are the same as in the MAIN MENU level, and they are not listed in this SCSI INITIATOR MENU. These are the RUN, PAUSE, or STOP used for starting, pausing, or stopping the trace, and QUIT for exiting from this menu. These functions are described in sections 2.2.2, 2.2.3, and 2.2.4 respectively.

We strongly recommend using an external keyboard for operating the SCSI Emulator. If you chose using the keypad however, move the highlight bar (using the arrow keys) over the selected command, then press the **<Enter>** key.

In the following paragraphs, individual auxiliary functions are explained in more detail. Functions are listed in alphabetical order. Functions such as

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"^X - Setup" and **"^D - Data Buffer Management"** are rather complex; they are described in sections 6.4 and 6.3 respectively.

MESSAGES PROGRAMMED BY THE USER:
SCSI Command Descriptor Blocks (CDB) can be preceded by one or more messages. The ANCOT Ultra-2000 allows the use of several of these messages in the same command. Each can be individually enabled or disabled, and its contents set. Enabled messages will be transmitted in the following order:

Identify message
Queue Tag message (2 bytes)
Custom User message (1 - 16 bytes)
WDTR (4 bytes)
SDTR (5 bytes)

Any of these might be rejected by the target, or have a response message-in phase. If so, the remainder of the list will be sent following the response. From the Initiator Emulator's perspective, the Custom User message is entirely rejected if any one byte is rejected.

Read Sections 6.2.14 and 6.4.5 for more detailed description of how to program custom messages.

6.2.1 <^A> - CHANGE LBA

This function lets you define the Logical Block Address to be used on the next command with such a field (e.g., a Read command). If the LBA bit of the AutoFill variable (see Section 6.2.6) is set, the LBA you define will be used for the next command.

6.2.2 <^B>, <^L> - MACROS

The Ultra-2000 Emulator's macro capability lets you define a sequence of commands and other functions which will execute sequentially at the press of a single key. The Emulator is shipped with several default macros installed. You can edit or rewrite them or you can use them as-is. However, each time you restore defaults, the original definitions will be restored as well.

The **"^B - Build Macro"** command allows you to construct a macro. The macro buffer is 64 characters long, so the macro can be quite complex. As you press each key, that character will become part of the macro, and will also be executed. When you complete your definition, press **<^B>** again. You can then save or discard the macro you have built. If you define an empty macro, it can be saved. This allows you to erase any previously defined macros. Macros may not be nested, i.e., you cannot make one macro part of another.

The **"^L - List Macros"** command displays all macros currently defined. It is important to realize that a macro is merely a list of keystrokes. This means that for items which merely toggle between states, like the "^G - Incr LBA @ Wt" command, will have an effect dependent on the initial state of the toggle. Some items require an **<Enter>** key press to end data input, like the "^A - Chng LBA" command. The **<Enter>** key is not shown as part of the macro, even though it will occur. Instead, the value entered as input is shown in curly brackets {}. Execute macros by pressing the corresponding number key in the range 1 through 8. Macros can be repeatedly executed if **"^Z - Repeat Command"** is enabled (see Section 6.2.13).

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6.2.3 <^D> - DATA BUFFER MANAGEMENT

This item gives access to the Data Buffer Management, which will display its own menu. See Section 6.3 for a complete discussion of the buffer management functions.

6.2.4 <^E> - EDIT CDB

This function allows you to set or clear any bit of any defined CDB (Command Descriptor Blocks), including the Vendor Unique CDBs. The current contents of the CDB selected are displayed, and you can change any or all of the bytes. The modified CDB is retained until you restore defaults (see Section 7.3.5).

You have complete control over seven custom CDBs, accessed via SCSI Command letters **<t>** through **<z>** (lower case). The defaults for these CDBs are all zeros, making them 'Test-Unit-Ready' commands. Using the **<^E> - Edit CDB** function, you can make them into any command, including the non-standard ones. You will be asked to specify In, Out, or No buffer, if the data phase for that particular command requires a buffer. All CDBs are stored in non-volatile memory (EEPROM) and will retain their contents even after a system reset.

Edit the CDBs as follows: Press the **<^E>** key to enter the 'Edit CDB' mode, and enter the letter representing the SCSI command CDB to be edited. Current CDB will be displayed in Hex format. Move cursor (using **<LeftArrow>** or **<RightArrow>** key) and change individual bytes. When finished, press **<Q>** to save the new edited values and return back to the Initiator Emulation menu.

Remember that while executing individual SCSI commands, certain fields will be filled in 'on the fly' if the ^H - Autofill function is enabled. Read more on this in Section 6.2.6 below.

6.2.5 <^F>, <^G> - INCREMENT LBA AFTER WRITE/READ

These options affect the value of the LBA variable after each SCSI Read or Write command. Note that this will affect the CDB only if AutoFill is enabled for LBA (see Section 6.2.6). If the incrementation is enabled, then the LBA is incremented as a 32-bit value. The upper bits of the value may be truncated if the CDB does not have room for all of them.

6.2.6 <^H> - AUTOFILL

Of particular interest is the **"^H - AutoFill"** selection. AutoFill, if fully enabled, will insert the current values for LBA, Allocation/Transfer Length, Link (and flag) bit and Target LUN into the CDB. Each of these items can be individually enabled or disabled, using the following values.

Selection Code	Affected field

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A	LBA
X	Alloc/transfer length
L	Link and Flag bits
U	LUN

Open the AutoFill field by pressing **<Enter>**, then using the selection codes, toggle individual selections ON and OFF; you can turn a particular bit ON to enable automatic fill of that field in any affected CDB. Turning it OFF leaves that field with the value it held on the previous use of the affected command. The selection code will toggle selections ON and OFF. The corresponding selection code will be displayed in 'upper case' for ON state, and in 'lower case' for OFF state. As an example, type **<U>** to enable and disable automatic filling of LUN in subsequent execution of commands. This AutoFill will be effective until the **<U>** is turned OFF (by typing **<U>** again). Similarly, it works with the L, X, or A selections respectively.

For example, to have the Emulator fill in the Link bit and the LBA, but to leave the LUN and transfer length alone: open the AutoFill field by pressing **<Enter>** then toggle the **<L>** and **<A>** codes; this selection will be displayed as 'A x L u'. The Emulator will then look at the current settings for the LBA to enter it into the CDB. It will also check how you want the Link and Flag bits set in the last byte of the CDB, and fill them in.

Note that the AutoFill for LUN does not affect the LUN field of the Identify message. That field will always hold the current value of the LUN variable.

6.2.7 <^I> - INITIATOR ID

Determines the SCSI ID number to be used by the Initiator Emulator. The ID number currently selected is entered in hex (0 through F). The corresponding bit will be asserted on the data bus during Arbitration to identify the Initiator.

6.2.8 <^K> - COMPARE BUFFERS

Selecting this option causes a byte-by-byte comparison of the current contents of the SCSI Read Data Buffer and the SCSI Write Data Buffer. Both of these buffers should have their lengths defined beforehand. See section 6.3.5 for details. If their lengths are different, then the shorter one will be used for the comparison. The number of mismatches is reported (e.g. 'K0003') if any is detected. If the buffers compare correctly, only 'K-' is displayed on the screen, and no other report is issued.

6.2.9 <^N> - LINK & FLAG BIT

This selection allows you to emulate linked commands. Using **<Enter>** you can change this variable to 3 possible states, as shown by the codes below:

Code	Function
blank	Link and Flag bits both cleared
L	Link bit set, Flag bit cleared
FL	Link and Flag bits both set

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The Link & Flag bits feature is intended to test target handling of linked commands. The Link bit is used to continue the I/O process across multiple commands. The Flag bit is typically used to cause an interrupt in the initiator between linked commands.

If this feature is used, the selected command will be sent by the initiator emulator of the Ultra-2000. The target should go through execution of this command, then respond with 'Intermediate-Condition met' (=14 hex) or 'Intermediate' (=10 hex) status, and 'Linked Command Complete' message-in, then again enter the command phase for the next command. The Ultra-2000 emulator will send the same CDB second time, this time with the Link bit reset. The target should execute this (second linked) command and should conclude it with status = 00 and message-in = 00. If an error occurs anytime during execution of the first command, 'Check Condition' status should be returned by the target and the command should terminate immediately without starting the second linked command.

6.2.10 <^R> - SCSI RESET

Selecting this option asserts the SCSI RST line, causing a Reset condition on the bus. The line is held asserted approximately 26 microseconds, then released. (The SCSI specification requires a minimum of 25 microseconds, with no maximum.)

6.2.11 <^T> - TARGET ID

Determines the SCSI ID number of the Target to be selected by the Initiator Emulator. The Target ID number currently selected is shown in hex, 0 through F. The corresponding bit for the currently selected Target ID will be asserted on the data bus during Selection.

6.2.12 <^U> - LOGICAL UNIT (LUN)

Determines the Logical Unit Number (LUN) in the Target to be selected by the Initiator Emulator. Enter the new LUN selection in the range 0 through 7.

6.2.13 <^X> - EMULATOR SETUP

This selection allows setting up various operating parameters for the SCSI Emulator. See Section 6.4 for a complete description.

6.2.14 <^Y> - QUEUE TAG

This selection is shown in the Emulation menu as **<^Y> - Queue Tag[ ][ ]**. When disabled, the two square brackets will be empty. When enabled, the first set of brackets holds a letter telling which type of tag will be used. Possible letters are :

<S> simple tag
<H> head-of-queue tag
<O> ordered tag

The second set of brackets holds the actual tag number that will be used.

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Select this option by pressing the **<^Y>** key, and a sub-menu will be displayed as shown below. This menu will allow enabling the function and setting the exact message content to be used.

```
QUEUE TAG MESSAGE MENU
-------------------------------
<1> - Disabled          (D)
<2> - Simple Queue      ( )
<3> - Head of Queue     ( )
<4> - Ordered Queue     ( )
-------------------------------
<5> - Tag number        [00]
-------------------------------
<Q> - Quit, Save Changes
<Esc> Quit, Discard Changes

Your selection (0../Q) ?
```

Only one of the first four options can be selected at any one time. If item 1 is selected (disabling tagged queued commands), the tag number will not be shown. The [E] shows which option is selected. To avoid confusion, if item <1> Disabled is selected, it is shown by "D" in the parentheses.

To select a different type of queue tag message, either type the number of the selection or move the highlight bar to that line and press **<Space>** or **<Enter>**.

6.2.15 <^Z> - REPEAT COMMAND

When enabled by **<Enter>**, this item causes the next command selected to be executed repeatedly until stopped by a keypress (any key). The halting keypress also disables repeating for subsequent commands until explicitly enabled again. Macros can also be repeated, just like individual commands.

6.3 <^D> - DATA BUFFER MANAGEMENT

This selection allows you to manipulate the data buffers used for SCSI commands. Menu selections allow you to fill the outgoing data with a variety of patterns, or to view and edit each individual byte. You can also view the contents of the incoming buffers from the previous SCSI command.

```
DATA BUFFER MANAGEMENT MENU
-------------------------------------------
<0> - Select Buffer...       [Data-Out]
<1> - View and Edit Buffer
<2> - Fill Buffer...
<3> - Copy Buffer...
<4> - Set Buffer Size           [$0200]
```


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6.3.1 <0> - SELECT BUFFER

Always select the proper buffer before viewing, editing, or filling it. Toggle the buffer selection using the arrow keys. The following buffers can be selected:

- (SCSI) Data In
- (SCSI) Data Out
- (Custom) User Message
- Mode Select (Data
- Mode Sense (Data)
- Request Sense (Data)
- Inquiry Data

The Custom User Message is a message-out which will be sent following Identify message, just before the Command phase. This would be the Abort, Queue Tag, vendor unique, or similar messages. The SDTR or WDTR would also be sent in this position; however, these two extended messages are rather complex and therefore are programmed from another menu: From the main menu, select **<E>** for Emulation, **<^X>** for Emulation Setup, and **<5>** for Data Transfer Protocol (SDTR & WDTR) menu.

When copying a buffer to buffer, the source buffer is designated on the **<0>**-Select Buffer line. You will be prompted to select the destination buffer when you type **<3>** for Copy Buffer.

6.3.2 <1> - VIEW AND EDIT BUFFER

This selection allows you to examine each byte of the active buffer. You can modify any or all of the bytes.

Editing is very simple. Use the cursor control keys (**<arrows>, <PgUp>**, etc) to move to the byte you want to change. Then type the new value for the byte. As long as you type keys which are valid hexadecimal digits, the cursor will move along in the buffer and the new data will replace the old. You can also use the cursor control keys to skip over or move back within the buffer. If you type only a single digit for a byte, then type **<Enter>** or some key which is not a valid hex digit, the digit you typed will be used as the value for the entire byte (it will appear as the low-order 4 bits). To end the editing session, press **<Quit>**. Keys which have no meaning in the context of the editor will be ignored. Note that many of the keys on the built-in keypad are interpreted as single characters and may be valid hexadecimal digits.

6.3.3 <2> - FILL BUFFER

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This option allows you to select or define a fill pattern which will replicate throughout the buffer. Using the **<left arrow>** or **<right arrow>** keys, select the following patterns:

zeros - every bit in the buffer will be turned off

ones - every bit in the buffer will be turned on

random - a pseudo-random pattern of byte value will be used to fill the buffer. The seed byte is generated by internal clock interrupt.

incr. - you will be asked for a pattern of up to 15 bytes. Type the desired pattern in Hex, separating bytes with spaces. The pattern will be used to fill the buffer. Each copy of the pattern will be incremented from the previous copy. For example, if you chose the pattern $A0 F2, the buffer will be filled with the following pattern:

```
address   Values

 0:     a0  f2  a0  f3  a0  f4  a0  f5  a0  f6  a0  f7  a0  f8  a0  f9
10:     a0  fa  a0  fb  a0  fc  a0  fd  a0  fe  a0  ff  a1  00  a1  01
```

const - you will be asked for a pattern like that for an incrementing fill. The pattern will be used (unchanged) to fill the entire buffer.

6.3.4 <3> - COPY BUFFER

This selection allows you to copy from the active buffer to any other buffer for outgoing data. If the buffers are the same size, the entire length will be copied. If the buffers are different sizes, only the length of the shorter one will be copied. The remainder of the longer buffer will be unchanged. You can copy any source buffer into (almost) any destination buffer; the exception for destination are the input buffers.

Before copying, always select the proper source buffer. Toggle the(source) buffer selection using the arrow keys in selection **<0>**. When you type **<3>** for Copy Buffer, you will be prompted to select the destination buffer.

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Select the destination using the arrow keys, then press **<Enter>** to execute the copy.

6.3.5 <4> - SET BUFFER SIZE

This selection allows you to specify the number of bytes in any of the buffers. Certain maximums must be observed, as shown in the table below:

Buffer	Maximum Size (decimal)		(hex)	Default (hex)
Read	64	Kbytes	10000	200
Write	64	Kbytes	10000	200
User Msg Out	16	Bytes	10	00
Req Sense Data	64	Bytes	40	20
Inquiry Data	128	Bytes	80	30
Mode Sense Data	255	Bytes	FF	FF
Mode Select Parms	255	Bytes	FF	C

6.4 <^X> - EMULATOR SETUP

Selecting option **<^X>** gives access to the various operating parameters of the SCSI emulator. Parameters can be changed through selections from this menu:

EMULATOR SETUP MENU

<0> - Alloc/Xfer Lengths...
<1> - Arbitration [E]

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```
<2> - Identify Message          [E]
<3> - Disconnect/Reconnect...   [E]
<4> - Custom Message...         [ ]
<5> - Data Xfer Protocols (W/SDTR)
<6> - Mode Sense/Select setup...
<7> - Target type...      [0(Disk)]
<8> - SCSI Version              [2]
<9> - Command Timeout           [E]
```

You can make your selections either by moving the highlight bar and pressing the <Enter> key, or directly by pressing the selector key listed along the left side on this menu. The left- and right-arrow keys change the current value in [ ] brackets.

6.4.1 <0> - ALLOCATION/TRANSFER LENGTHS

This selection gives access to control of the amount of data to be transmitted or received and saved during various data phases. All numeric entries are in hex (0 - F). See section 6.3.5 for maximum allowable values.

The menu for these selections is as follows:

```
      ALLOCATION / TRANSFER LENGTHS
_____________________________________________________
<0> - Xfer Len - Rand Acc       [00000001] blocks
<1> - Xfer Len - Seq Acc/Proc/Comm[000200] bytes
<2> - Target Block Size             [0200] bytes
<3> - Alloc Length for Request Sense [020] bytes
<4> - Alloc Length for Inquiry       [030] bytes
```

<0> - Initiator Transfer Length for random access device type: a value which will be filled in the TxLgh field of Read/Write type commands if 'Autofill' is enabled.

<1> - Initiator Transfer Length for Seq.Access, , Processor, or Communications device type: a value which will be filled in the TxLgh field of Read/Write type commands if 'Autofill' is enabled.

<2> - Target Block Size: defines the data block size expected in the Target. Data buffer used by the Read/Write type commands will be sub-divided based on this value.

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<3> - Allocation Length for Request Sense: a length of buffer allocated for Sense data received from the Target in a Request Sense command. The maximum value is 20 hex. This value will be filled in the Allocation Length field of a Request sense command if 'Autofill' is enabled.

<4> - Allocation Length for Inquiry: a length of buffer allocated for Inquiry data received from the Target in a Inquiry command. The maximum value is 40 hex. This value will be filled in the Allocation Length field of an Inquiry command if 'Autofill' is enabled.

6.4.2 <1> - ARBITRATION

For SCSI-2, Arbitration is mandatory. However, in SCSI-1, it was optional and some very early systems did not arbitrate. This selection allows you to disable Arbitration in order to emulate those early SCSI-1 systems. Note that by disabling Arbitration, the Disconnect / Reconnect option will also be disabled.

6.4.3 <2> - IDENTIFY MESSAGE

This selection determines whether Selection with Attention will be used to signal a desire by the Initiator to send a Message Out to the Target before the CDB. This message phase is normally used for an Identify Message, for Queue Tag messages and for Protocol Negotiations. When Arbitration is disabled, Identify Message is also disabled.

6.4.4 <3> - DISCONNECT / RECONNECT

This selection determines whether the Target will be allowed to disconnect during the command. When emulating a SCSI Initiator, the Identify message will have the "disconnect permission" bit (bit 6) cleared as a default. When Arbitration or Identify Message is disabled, the Disconnect is also disabled.

6.4.5 <4> - CUSTOM MESSAGE

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This selection allows you to specify an extension to the initial Message-Out phase of a command, and the bytes to be sent in that extended phase. Selecting this option gives access to the following menu:

```
  CUSTOM MESSAGE MENU
_____________________________

<0> - Edit msg-out buffer
<1> - Use [   never]

Your selection (0../Q) ?
```

Press **<Enter>** with bar over the **<0> - Edit buffer** or press **<0>** to open another window, showing the current contents of the buffer. Only those bytes up to the current length are shown. The cursor will be on the first byte of the buffer. To add bytes to the buffer, simply press the down arrow key and the cursor will move to a new byte, up to a total of 16 bytes. When you enter a value for the byte, the meaning will be shown to the right. To change an existing byte, move the cursor to that byte and type the new value. Press **<Q>** to stop editing and save the new buffer.

Selecting **<1> - Use** will toggle between the options "never", "always" and "next cmd".

6.4.6 <5> - DATA PROTOCOLS

This selection allows you to control the way that data is transferred during either the Data-In or Data-Out phases. Selecting this option gives access to the following menu:

```
DATA PHASE TRANSFER PROTOCOLS
_____________________________________________

<0> - Synchronous Transfers          [E]
<1> -    Offset                     [16]
<2> -    Period(ns)                [100]
<3> -    Resp w/ Msg Reject          [N]
<4> -    Negotiation           [RqS/Inq]
<5> - Wide Transfers                 [E]
<6> -    Transfer Width             [16]
<7> -    Resp w/ Msg Reject          [N]
<8> -    Negotiation           [  Never]
```


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SCSI-3 provides for FAST/20 (rates above 10MHz and below 20MHz) and WIDE (2 bytes) data transfer modes. Note, that only Data Phases In/Out will use these modes. All other phases (Command, Status, Message phases) always use asynchronous and single-byte transfer mode. Also note, that before FAST/20 and/or WIDE are used, they must be negotiated between each Initiator and Target. A SCSI system can have a mix of devices, each using a different mode. It is also provided for SCSI-1 devices that neither recognize nor support these modes; these devices will reject the SDTR (Synchronous Data Transfer Request) and WDTR (Wide Data Transfer request) extended messages. SDTR and WDTR negotiations usually occur during the power-up sequence, and positioned immediately after Identify message, just before the command phase. The SDTR and WDTR extended messages are attached to Request-sense and/or Inquiry commands. Consult the SCSI specifications for detailed rules defining use of these messages.

When making selections from the menu, use arrow keys to toggle between values within allowed limits.

Items **<0>** and **<5>** are used for enabling the use of SDTR and WDTR extended messages to negotiate synchronous and wide data transfer modes. If enabled, format of the SDTR and WDTR will be defined by parameters, as currently selected. Also note that enabling synchronous or wide transfers still requires negotiation. See items <4> and <8>.

Item **<1>** allows you to select the maximum synchronous offset allowed during data transfers. Offsets up to 16 (hex 10) are supported.

Item **<2>** allows you to select the synchronous rate. Rates are selectable from 48 ns to 440 ns when using FAST synchronous transfers, and from 200 ns to 875 ns when using normal synchronous transfers. This gives a range of rates from approximately 1.4 MHz up to the maximum of 20 MHz allowed by SCSI-3.

Items **<3>** and **<7>** allow you to select how the Emulator responds to WDTR/SDTR negotiations when a particular transfer type is disabled. If "Respond w/ Msg Reject" is enabled, the emulator will reject WDTR and/or SDTR extended messages. If disabled, it will respond with an extended message which shows an inability to transfer data with the protocol

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requested. For example, if Wide Data Transfers are disabled, and the Emulator receives a WDTR extended message, it will respond with a WDTR extended message showing '0' for the width byte. Similarly, the SDTR message response will have a 0 offset byte.

Items **<4>** and **<8>** allow you to decide when WDTR / SDTR negotiation should be done:

a) never,
b) next command,
c) on each Request Sense or Inquiry command.
d) on every command

The SCSI-2 specification recommends negotiating with each Request Sense or Inquiry command. If the "next command" is selected, this function will revert to "never" after that command.

Item **<6>** allows you to select either 8-bit or 16-bit data transfers.

6.4.7 <6> - MODE SENSE / SELECT SETUP

Selecting this option gives access to the following menu.

```
   MODE SENSE / MODE SELECT MENU
_____________________________________________

<0> - Mode Sense Alloc Length (In)      [$24]
<1> - Mode Select Param List Length     [$0C]
<2> - Edit Mode Select Parameter List
<3> - Copy Mode Sense Data to Mode Select Parms
```

Item **<0>** specifies the buffer size in bytes allocated by the Initiator for Mode Sense data received from the Target.

Item **<1>** specifies the number of bytes which the Initiator will send, if the Target allows it, as parameters of the Mode Select Command.

Item **<2>** allows you to view and change the data sent as parameters. This acts the same as the Data Buffer Management menu.

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Item **<3>** allows you to copy Mode Sense Data, as received from the Target, to the Mode Select Parameter List buffer before sending it back to the Target. This would be useful when you are experimenting (editing) with certain parameters, but want to preserve the rest as it is.

6.4.8 <7> - TARGET TYPE

This selection allows you to specify the type of target addressed by following commands. Several commands vary in the contents of the CDB and the meaning of the bits in the CDB depending on the target type. Currently the supported target types include :

Type 0 - Random Access Devices (Disk drives. Many of these commands will act the same way for Optical drives, CD-ROM drives and similar devices)

Type 1 - Sequential Access Devices (Tape drives)

Type 3 - Processor Devices

If interest warrants, other device types will be added in the future. Commands which apply to all devices can, of course, be sent to any device type. Also, using the vendor specific commands, you can define commands for other device types.

6.4.9 <8> - SCSI VERSION

This selection allows you to specify whether to use SCSI-1 or SCSI-2 protocols. Only a few commands are affected by the SCSI version. If you are not sure which version is supported by the device being addressed, we recommend that you select SCSI-2 version.

6.4.10 <9> - TIMEOUT SELECTION

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Timeout options determine how the Emulator will behave if the device being addressed does not respond in a timely manner. If enabled, timeout will abort the current command by issuing a SCSI RESET condition if the command has not completed within approximately two seconds.

It is important to disable timeout if you are going to issue a command that is not expected to complete within the timeout period, such as a tape rewind command, or a disk format command.

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SECTION 7

UTILITIES

7.1 INTRODUCTION

Several utility functions are provided in the Ultra-2000. See section 5 for a discussion of the built-in search capability. The other functions are described below.

7.2 CALCULATING ELAPSED TIME IN TRACE

From the main menu, press **<7>** or **<Ctrl-T>** to access this utility. This function can also be accessed from any screen of trace memory display by pressing **<^Time>**, or **<^T>** on the external keyboard.

You will be asked to provide two trace memory addresses. These may be entered in either order. The utility then examines the time stamp for each event, and reports the time elapsed from the earlier event to the later event. Note that elapsed time is modulo about 170 seconds, the timer wrap-around period. Thus if the actual elapsed time was 175 seconds, the utility function will report a time of about 5 seconds.

```
CALCULATE TIME DIFFERENCE
      From address :  [    1]
        To address :  [000B0]
   Time difference :   1.689 994 440
```

The *'from'* and *'to'* addresses are automatically filled in as default values, and may be typed over. The *'from'* address is always = 1, and the *'to'* address is the currently used trace memory end. The time difference is in nanoseconds. In the example above, it is 1 second, 689 milliseconds, 994 microseconds, and 440 nanoseconds.

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7.3 THE UTILITY FUNCTIONS MENU

From the main menu, press **<Util>** or **<8>** or **<U>**. A second level menu will appear, the UTILITY FUNCTIONS MENU, in the following format:

```
UTILITY FUNCTIONS MENU
---------------------------------------
<0> - Screen saver                  [E]
<1> - Echo trace display to printer [ ]
<2> - Printer timeout               [E]
<3> - Show system configuration
<4> - Restore system defaults
<5> - Load new firmware
<6> - Remote control via serial port[ ]
<7> - Set serial port parameters
<8> - Set time/date

Your selection (0../Quit) ?
```

Make your selections either by entering the **<Number>** directly (e.g., select 4 for "restore system defaults"), or by moving the highlight bar over the chosen line, using the Arrow keys and pressing **<Enter>**. Individual functions are explained below.

7.3.1 <0> - USING THE SCREEN SAVER

Electro luminescent displays like the one in the Ultra-2000 are subject to 'screen burn-in' if the contents of the screen do not change for a long period of time; a screen may show a ghost of a previous image. To prevent this effect, the display has a screen saver feature. If a significant time passes with no keyboard or display activity, the screen will blank. To bring it back, press any printable key; the Ctrl, Alt, or other such keys would not work.

You can turn off the screen saver feature from the UTILITY FUNCTIONS MENU. Choose item **<0>** to toggle between enabled or disabled screen saver.

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7.3.2 <1> - PRINT DISPLAY INFORMATION

You can print a hard copy of the trace information, just as it appears on the screen. The LED near the bottom of the front panel, by the **<^Print>** key, tells if printing is enabled. When the LED is lit, each line of trace memory displayed to the screen will also be sent to the parallel printer connector. Some displays use the IBM PC Extended Character Set for ASCII graphics. Be sure that your printer has this font selected.

All trace display formats can be printed except the 'Command Profile'.

Printing can be enabled or disabled by pressing **<Ctrl-P>** on the keypad or external keyboard anytime, from any menu level, even in the middle of displaying. Another method is selecting item **<1>** in the UTILITY functions menu. The **<Enter>** key toggles between enabled shown as 'E' in the square brackets, and disabled shown by empty brackets.

When using a PC for remote control, use the **<Alt-P>** instead: the **<Ctrl-P>** is used by the PC locally. However, when using the PROCOMM package on the PC, the printing function cannot be used at all, because PROCOMM 'swallows' the **<Alt-P>**.

7.3.3 <2> - PRINTER TIMEOUT

When enabled, this option will limit the timeout delay if the printer is not responding. After a few seconds, the character waiting to be sent to the printer will be discarded and printing will be disabled, as shown by turning off indicator LED on the front panel.

When disabled, the BIOS will wait indefinitely until the printer is ready and connected. To recover from a printer "hang", either connect a printer or press **<SystemReset>**

Note: any trace will be lost.

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7.3.4 <3> - SHOW SYSTEM CONFIGURATION

Choosing this option will display on the screen all of the system options retained through the power Off-On cycle, stored in non-volatile memory. Scroll through the screens with **<Next>** or **<Prev>**.

To print the configuration, enable printing before you choose this menu selection. If you are already displaying the information, press **<^Print>**, then **<Next>** or **<Prev>**. If any of the options are printed, they will all be printed (about 3 pages).

You can also see the default values for the system configuration. Press **<Flip>** to toggle between defaults and current values.

7.3.5 <4> - RESTORE SYSTEM DEFAULT PARAMETERS

With this selection, all of the variables stored in EEPROM will be restored to their default values. Similarly, the variables in SRAM are restored to the power-on state.

7.3.6 <5> - LOAD NEW FIRMWARE

This function allows you to download a new firmware version into the Ultra-2000 flash memory. You will be asked to confirm your choice. Read Section 8.6 for a more detailed description.

7.3.7 <6> - REMOTE CONTROL FROM AN EXTERNAL HOST (PC) or USING THE Ultra-2000 AT A REMOTE LOCATION

There are situations when a SCSI system at a remote location needs testing or troubleshooting. It is possible to connect the Ultra-2000 Analyzer to the SCSI bus to be tested, and connect the controlling terminal over a modem, or via a null modem cable.

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The operator at Site A, the test site, connects the Ultra-2000 to the SCSI bus system as usual. the test site (we will call this site-A, and the receiving end site-B) simply connects. The Ultra-2000 Serial-1 Port is then connected to the modem port; the terminal, or host computer, is connected to the other end of the telephone line, Site B. If Site-A and Site-B are close together, a null modem cable can be used instead. See Appendix A for the pinout.

Site-A setup: connect the Ultra-2000 to the SCSI bus under test, and enable the remote control by selecting the UTILITIES menu, and starting selection **<4>**. A message will appear on the screen asking for confirmation. Press **<Yes>** to confirm this, and the message

THIS UNIT IS UNDER REMOTE CONTROL - DO NOT DISTURB

appears on the screen. At this point, the keypad, or a keyboard if connected to J4, is disabled. The Ultra-2000 can be restarted, to restore control from site-A, by pressing the SYSTEM RESET push button, or by turning the power OFF and ON.

Site-B operation: log onto the remote terminal or host computer, and start the communications utility program (BITCOM, PROCOMM or similar, using the VT-100 setting). The screen should clear, and the UTILITY menu from the Ultra-2000 (from site-A by modem) should display on your screen. At this point, the keyboard on your remote terminal should act as if connected directly to the Ultra-2000; all functions on the Ultra-2000 should be operational.

When finished with the session, select the Utilities menu from your remote terminal, select item 4 to disable remote control, and confirm the selection by pressing **<Y>**. Control will return to the Ultra-2000 local screen and keyboard. Remote control can also be disabled by pressing the SYSTEM RESET switch on the Ultra-2000 front panel, or by cycling power to the Ultra-2000.

The terminal used for remote control should support the ANSI escape sequences for clearing, moving the cursor, and for inverse video. See Appendix B for definitions of the sequences used.

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7.3.8 <7> - SET SERIAL PORT PARAMETERS

This option allows you to specify the exact RS-232 protocol to be used for transfers, including baud rate, number of data bits, stop bits, and parity.

A list of the current settings will appear on the screen. Use the up or down arrow keys to move the highlight to the item you wish to change. Use the left or right arrow keys to scroll through the available options for that item. When all items are correct, press **<Enter>** to record them and exit. The settings are also stored in non-volatile EEPROM memory and will be used as a default next time you do any communications, even after power OFF/ON.

The following settings are selectable:

Baud rates : 110, 300, 600, 1200, 2400, 4800, 9600, 38.4k, or 115.2k
Number of data bits : 5, 6, 7 or 8
Parity : even, odd or none
Stop bits : 1 or 2

When shipped from the factory, the Ultra-2000 default setting is:

9600 baud
8 data bits
no parity
1 stop bit

NOTE: While some communications programs allow setting the 115.2k baud, some computers may not be able to use this rate. This may result in lost characters or cause the computer to "hang". If this happens, use a lower baud rate.

7.3.9 <8> - Set Time/Date

This allows you to change the date and time on the Ultra-2000. These entries are used by the disk software to assign a creation date and time for any saved traces or setups.

A one-line display appears below the utility menu as shown here:

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```
      SET TIME & DATE:   15:01:37,  Tue,  Mar 11, 1997
```

The field currently being edited appears in reverse video. The up and down arrows change the value in the highlighted field, and the right and left arrows move to the adjacent field. "Q" exits and saves the settings.

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SECTION 8

INSTALLATION

8.1 UNPACKING

Inspect the shipping carton for signs of damage before opening. If there is any evidence of damage, notify the carrier and ANCOT immediately.

Remove the instrument and all accessories from the shipping carton, and compare the contents with the parts list accompanying the package, or listed on the packing slip. If any equipment is missing, contact the ANCOT local representative or ANCOT directly as soon as possible.

You may want to save the shipping carton for return of the equipment for factory service, if that is required.

8.2 INITIAL TURN-ON

Connect the line cord to the AC module on the front panel of the Ultra-2000, and plug it into the three-pin 110-220 Volt wall outlet (the power supply is auto-ranging). If a three-pin outlet is not available, use a two-pin socket with a proper ground wire attached and connected to ground.

If you want to use an external keyboard with your Ultra-2000 rather than the built-in keypad, connect its cord to the KBD connector. Note that this keyboard should be the newer PC/AT type, one, which does not require initialization from the host: the Ultra-2000 does not initialize the keyboard.

Turn the power ON. During the Power-UP sequence, all memories in the system are diagnosed automatically. You will be notified at this time if any errors are detected by the Power-UP diagnostic. If no errors are detected, the main menu will be displayed on the screen.

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If a printer is to be used, connect it by a standard PC/AT printer cable to the DB-25 parallel port connector on the front panel of the Ultra-2000. The printer should be any standard parallel type. For the parallel DB-25 connector pinout see Appendix A.

The unit has all setup values preset to their defaults at the factory; all basic functions should be operational. However, setup values may be changed using the various selections in the individual menus, or directly from the main menu.

Turn on the Ultra-2000/Lite by using a null cable (see description in Appendix-A) and connecting the external host (PC) to the Serial-1 port on the back panel of the Ultra-2000/Lite. Connect the external power supply to the 5-pin DIN power connector on the back panel of the Ultra-2000/Lite, and plug its power core in the 110/220 Volt outlet. Turn the host (PC) on and start the communications program PROCOMM or similar. See Appendix G for the PROCOMM setup and operation description. You should get the first screens on your host (PC). From here on, everything is the same as with the Ultra-2000.

8.3 INITIAL CHECK-OUT

Connect a SCSI cable to an active SCSI bus. Be sure that termination is appropriate. The TERMPWR LED located by the used SCSI connector should be on.

Press **<Run>**. Allow enough time for some activity to occur on the SCSI bus. You will see the SCSI Control and Data LEDs flash on and off with the activity. Press **<Stop>**. A message will appear on the screen telling the end address of the recording. If this address is 0 or 1, contact the factory.

Press **<Display>** and **<Enter>**. You will see the recorded trace. Press **<Flip>** to change the display format. You may want to experiment with other recording modes and with triggering at this point.

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8.4 COMMUNICATION, INTERFACING, AND SETUP

When using a remote CRT terminal or PC connected via the Serial-1 port directly or over a modem, a compatible communication format and protocol must be used. To help the user to install, the Serial-1 I/O port is programmed at the factory to a default set of parameters. These are:

Serial-1 port:	9600 baud
	8 data bits
	no parity
	1 stop bit
	RTS and CTS is not used

Note that Serial-1 when communicating with a CRT terminal uses the X-On/X-Off protocol; only signal pins 2 and 3 are used.

Selections described above are stored in the non-volatile EEPROM, and do not need to be selected again, unless different values are required. Set different parameters using ***'<6>*** - *Setting Serial Port Parameters'* function from the Utilities menu. This is described in section 7.3.7.

If you have problems communicating with the Ultra-2000 because the serial port is configured wrong, you press the SCSI RESET push button and hold it down while resetting the unit with the SYSTEM RESET push button. You may do the same by turning the power off and on again, while holding the SCSI RESET. This sequence will reset the Serial-1 port to its default (9600 baud) setting.

You may need to use this procedure only with the Ultra-2000/Lite, because you can access this analyzer only from the external terminal / PC. When using the Ultra-2000 portable model however, you can always restore defaults from the built-in screen and keypad, using the utilities *'restore defaults'* function. The internal screen and keypad are independent from the Serial-1 port setting.

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8.5 EPROM UPGRADES

Flash memory holds the executable programs that control all operation of the Ultra-2000 analyzer. The flash memory also holds the boot routine used for power up during normal operation. The EPROM holds the primary (very basic) boot code that is used only when there is no valid code in the flash memory. After a valid executable program (including boot) is loaded to the flash memory, the EEPROM takes over.

We expect that the user will never need to replace the EPROM with the primary boot code. However, in this chapter we describe the procedure for replacing the EPROM just in case.

The following instructions explain how to install an updated primary boot code EPROM into your ANCOT Ultra-2000 SCSI Bus Analyzer. If you decide that you want the factory to install your upgrade for you, contact ANCOT directly.

- In the Ultra-2000, remove the briefcase cover to reveal the instrument front plate. In the Ultra-2000/Lite, remove the top cover.

- Make sure that all cables are disconnected from the front plate, including the power cable.

- Remove the 8 black Phillips screws (2 on each edge) holding the front plate to the briefcase housing.

- Carefully lift the front plate and the attached circuit boards and metal pan from the briefcase housing. Place the assembly on a flat surface.

- Locate the main circuit board. It is the largest PCB, attached directly to the metal pan on the bottom. Find the firmware EPROM to be replaced: it is the big 32-pin (.600") chip on the left side of the main PCB, with an ANCOT label. It has the Ultra-2000 instrument identification and firmware revision number printed on it. Use a flat blade screwdriver to disengage the EPROM from its socket.

Insert the new version EPROM into the same socket. The small notch on the ceramic DIP chip should be on the same side with the marker on the PCB (orientation is the same as the other chips on that PCB). Be sure that all the pins are aligned with the holes in the socket, before pressing the chip firmly into the socket. Check the pins again to be sure none of them were damaged during insertion.

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To verify correct installation, apply power and the unit should display the main menu with the new revision number in the bottom right corner. Then remove the power cable again

Reinsert the electronics assembly into the briefcase housing. The handle of the briefcase should be at the top side of the display screen. Insert the eight screws to hold the electronics assembly in the briefcase housing. Tighten the screws firmly, but not overly so. Attach the briefcase lid. In the Ultra-2000/Lite, replace the top cover.

Your Ultra-2000 is now ready for use with the upgraded firmware.

8.6 FIRMWARE UPGRADES (Flash Memory

Flash memory holds the executable programs that control all operation of the Ultra-2000 Analyzer. The flash memory also holds the boot routine used on power up during normal operation. In order to upgrade the Ultra-2000 operation, new firmware must be downloaded through the Serial-1 port on the Ultra-2000 front panel. You must use a null modem cable and a communications program running on a PC. ANCOT recommends using the PROCOMM set at a speed of 115.2 k baud. Downloading new firmware at the 115.2 k baud rate will take about 90 seconds.

The download program can be entered by selecting **<5>** *Load new firmware'* function from the Utilities menu. Another method of entering the download program is to press the SYSTEM RESET button on the Ultra-2000 front panel and then press the **<Esc>** key or the **"q"** key when the following message appears:

To download new firmware press ESC or "q" now!!

This message will last for about 2 seconds.

Once the download program has been entered, select the fastest baud rate that your communications program can use by using the **<Up-arrow>** or **<Down-Arrow>** keys, and press **<Enter>.** Then press the **<Yes>** or **<Y>** keys to put the Ultra-2000 in the download mode. The message *"Waiting for S-Records"* will appear. At this point, start the download from the PC using the communications program with the baud rate set to match the baud rate selected on the Ultra-2000. The file to download is supplied as "u2000.chk" by ANCOT. The progress of the

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download will be displayed on the Ultra-2000 screen. At the completion of downloading, the system will re-boot with the new firmware.

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SECTION 9

OPTIONS

9.1 INTRODUCTION

ANCOT has developed several optional software applications which may be used with the Ultra-2000 SCSI Bus Analyzer/Emulator. These applications are available from the factory and are supplied in a file in Motorola S-Record format for downloading from a host computer to the Ultra-2000 via the serial port.

Each application has its own user manual. The descriptions which follow are not intended to be complete guides, but rather an indication of the capabilities of the applications.

9.2 THE APPLICATIONS

9.2.1 ANTEST - THE DISK TEST PROGRAM

ANTEST is ANCOT's Disk Exerciser/Tester Program. It is available on several platforms, including the Ultra-2000. It is useful for acceptance testing, production testing, or for debugging disk drives. ANTEST is completely menu driven for ease of use. Its reports are sent to the user's screen, a parallel printer, and through the serial port, to a file on a host computer.

ANTEST is capable of numerous tests, to check all aspects of operation of the disk drive under test. These tests include:

Write-Read-Compare
Read (Check for bad data blocks)
Seek time
Data transfer rate
Spin-up time

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Start-up time
Throughput rate in I/Os per second
Comprehensive test
Conformance test

The user has complete control over the test activity. With a setup menu, select synchronous or asynchronous data transfers, wide (16-bit) or narrow (8-bit) data transfers, Initiator and Target ID numbers, and the Logical Unit number.

With other setup menus, the user can control the length of tests, the actual bytes sent to the target, the range of scan of blocks on the disk, etc.

The reports generated by ANTEST are in 40-column format, suitable for printing by ticket printers, for attachment to the drives tested. Pass/Fail is clearly indicated for each test, based on criteria you select.

ANTEST requires the Initiator Emulator option to be installed on the Ultra-2000. It uses the emulator to issue the commands to the device under test.

9.2.2 C LANGUAGE CROSS COMPILER

ANCOT offers a compiler which runs on an IBM PC or compatible, and produces native code to execute on the Ultra-2000. It includes a library of functions for easy use of the capabilities of the Ultra-2000.

Using this compiler, you can write programs to automate testing and monitoring of the SCSI bus using the Ultra-2000. ANCOT's disk testing program, ANTEST, mentioned above, was constructed using this compiler.

You can download the programs into the system flash memory via the serial port from your host PC. Example programs are provided showing how to use the features in the ANCOT SCSI Library which accompanies the compiler.

Several of the functions in the ANCOT SCSI Library, supplied with the cross compiler, use the Emulation Board option of the Ultra-2000. If you call one of these functions in your program, and the emulator is not present, the program will hang.

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A P P E N D I X A

EXTERNAL CONNECTOR PIN ASSIGNMENT AND CABLES

A.1 I/O INTERFACE CONNECTORS

Parallel PRINTER Port (DB—25)

1	STB—	14	AFD—
2	PD0	15	ERR—
3	PD1	16	INIT—
4	PD2	17	SLIN—
5	PD3	18	GND
6	PD4	19	GND
7	PD5	20	GND
8	PD6	21	GND
9	PD7	22	GND
10	ACK—	23	GND
11	BUSY	24	GND
12	PE	25	GND
13	SLCT		

Serial-1 or Serial-2 I/O Ports RS—232 (DB—9)

1	DCD
2	RXD
3	TXD
4	DTR
5	Signal GND
6	DSR
7	RTS
8	CTS
9	RI

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A.2 AUXILIARY CONNECTORS

Expansion Port (DB—15)

1	bit 0	9	+5 Volt *
2	bit 1	10	Signal GND
3	bit 2	11	Reserved
4	Reserved	12	Reserved
5	Reserved	13	Reserved
6	Reserved	14	Signal GND
7	Reserved	15	+5 Volt *
8	Reserved		

*) Up to 100 mA is available from this Vcc source.

External KEYBOARD PC/AT type Port marked "KBD"

1	CLK	4	Signal GND
2	DATA	5	+5 Volt
3	N.C.		

External TRIGGER INPUT (BNC)

center pin — Ext.Trigger signal
shell — Chassis GND

The signal should be TTL level. It is received in the input side of the LS14-type receiver. This line is internally pulled up by a 1k ohm resistor to the +5 volt level.

External SYNCH OUTPUT (BNC)

center pin — Ext.Synchr signal
shell — Chassis GND

The signal is a standard TTL level, driven by a 20 mA driver.

5-VOLT DC POWER INPUT (5-pin DIN)

1	+5 volt
2	GND
3	GND
4	GND
5	+5 volt

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A.3 SCSI SINGLE-ENDED 68-pin CONNECTORS

68 pin HD 'P' type

1	GND	35	D12–
2	GND	36	D13–
3	GND	37	D14–
4	GND	38	D15–
5	GND	39	DPAR1–
6	GND	40	D0–
7	GND	41	D1–
8	GND	42	D2–
9	GND	43	D3–
10	GND	44	D4–
11	GND	45	D5–
12	GND	46	D6–
13	GND	47	D7–
14	GND	48	DPAR–
15	GND	49	GND
16	DIFFSENS	50	GND
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	open	53	open
20	GND	54	GND
21	GND	55	ATN–
22	GND	56	GND
23	GND	57	BSY–
24	GND	58	ACK–
25	GND	59	RST–
26	GND	60	MSG–
27	GND	61	SEL–
28	GND	62	C/D–
29	GND	63	REQ–
30	GND	64	I/O–
31	GND	65	D8–
32	GND	66	D9–
33	GND	67	D10–
34	GND	68	D11–

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A.4 SCSI DIFFERENTIAL HVD/LVD 68–pin CONNECTORS

68-pin HD 'P' type for the HVD (High Voltage Differential)

1	D12+	35	D12–
2	D13+	36	D13–
3	D14+	37	D14–
4	D15+	38	D15–
5	DPAR1+	39	DPAR1-
6	GND	40	GND
7	D0+	41	D0–
8	D1+	42	D1–
9	D2+	43	D2–
10	D3+	44	D3–
11	D4+	45	D4–
12	D5+	46	D5–
13	D6+	47	D6–
14	D7+	48	D7–
15	DPAR+	49	DPAR–
16	DIFFSENS	50	GND
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	open	53	open
20	ATN+	54	ATN–
21	GND	55	GND
22	BSY+	56	BSY–
23	ACK+	57	ACK–
24	RST+	58	RST–
25	MSG+	59	MSG–
26	SEL+	60	SEL–
27	C/D+	61	C/D–
28	REQ+	62	REQ–
29	I/O+	63	I/O–
30	GND	64	GND
31	D8+	65	D8–
32	D9+	66	D9–
33	D10+	67	D10–
34	D11+	68	D11–

68-pin HD 'P' type for the LVD (Low Voltage Differential)

1	D12+	35	D12–
2	D13+	36	D13–
3	D14+	37	D14–
4	D15+	38	D15–
5	DPAR1 +	39	DPAR1-
6	D0+	40	D0–
7	D1+	41	D1–
8	D2+	42	D2–
9	D3+	43	D3–
10	D4+	44	D4–
11	D5+	45	D5–
12	D6+	46	D6–
13	D7+	47	D7–
14	GND	48	GND
15	DPAR+	49	DPAR–
16	DIFFSENS	50	GND
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	open	53	open
20	GND	54	GND
21	ATN+	55	ATN–
22	GND	56	GND
23	BSY+	57	BSY–
24	ACK+	58	ACK–
25	RST+	59	RST–
26	MSG+	60	MSG–
27	SEL+	61	SEL–
28	C/D+	62	C/D–
29	REQ+	63	REQ–
30	I/O+	64	I/O–
31	D8+	65	D8–
32	D9+	66	D9–
33	D10+	67	D10–
34	D11+	68	D11–

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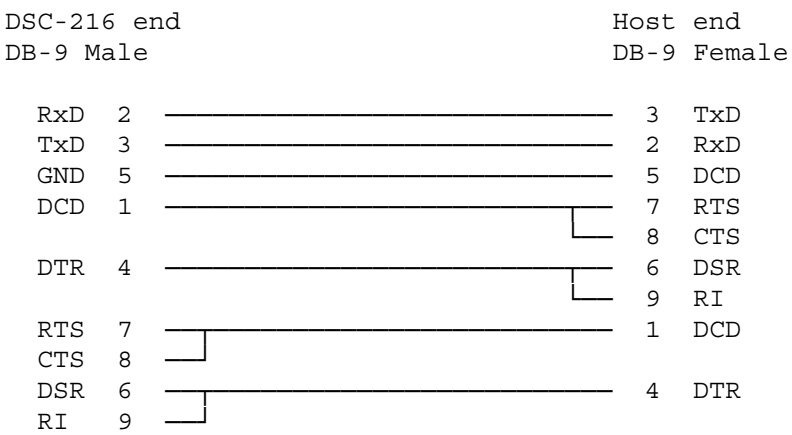
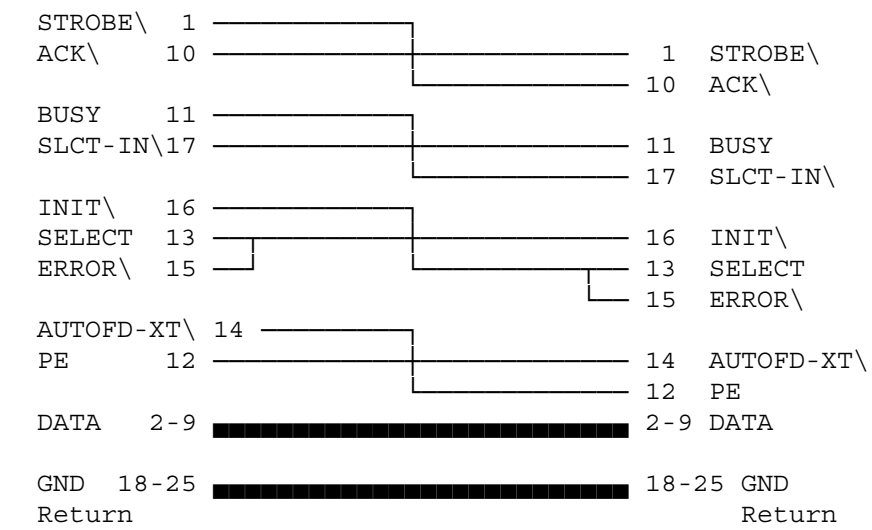
A.5 NULL MODEM CABLE

NULL MODEM CABLE WITH DB—9 HOST CONNECTORS



A.6 CABLE ADAPTER FOR TRACE UPLOAD USING THE PARALLEL PORT

DB-25 TO DB-25 CABLE (PC-AT to Ultra-2000 Parallel J1)



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A P P E N D I X B

ESCAPE SEQUENCES USED IN SCREEN CONTROL

B.1 GENERAL

Any terminal or computer emulating a terminal connected as a remote display device for the ANCOT Ultra-2000 SCSI Bus Analyzer will need to recognize and act on the following Escape sequences. Each sequence begins with an introducer sequence, followed by one or more parameters, followed by a terminating character.

The introducer sequence is either a single Esc character (1B hex) or the Esc character followed by a single '[' character (5B hex).

Parameters are decimal numbers transmitted as the ASCII characters '0' (30 hex) through '9' (39 hex). Parameters are separated from each other by the ';' character (3B hex). In cases where the parameter value is negative, the ';' character is replaced by a ':' character (3A hex). There are no negative parameters in any of the sequences currently used.

The terminating character is always a printable ASCII character, usually either an upper or lower case letter. Terminating characters differ depending on the purpose to be accomplished by the escape sequence.

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B.2 ESCAPE SEQUENCES - OUT (from Ultra-2000 to Terminal)

CHARACTER ATTRIBUTE SEQUENCES:

<Esc>[0m	Sets attribute to normal video (bright character on dark background)
<Esc>[7m	Sets attribute to inverse video (dark character on bright background)

SCREEN CLEARING SEQUENCES:

<Esc>[0J	Clears from cursor to end of screen
<Esc>[2J	Clears entire screen
<Esc>[0K	Clears from cursor to end of line
<Esc>[2K	Clears entire line

CURSOR MOVEMENT SEQUENCES:

Sequence sent to the terminal to move the apparent location of the cursor displayed:

<Esc>[<row>;<column>H	Move cursor to row <row> and column <column>.

For all movement commands, the screen is assumed to have 25 rows, numbered from 1 to 25, and 80 columns, numbered from 1 to 80. If a parameter is missing or outside the range, 1 is used.

B.3 ESCAPE SEQUENCES - IN (from Terminal to Ultra-2000)

<Esc>A	Move cursor up
<Esc>B	Move cursor down
<Esc>C	Move cursor right
<Esc>D	Move cursor left

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A P P E N D I X C

TRACE UPLOAD / DOWNLOAD FORMATS

C.1 HEADER / TRAILER INFORMATION

Each file transmitted has a 128-byte header, consisting of the following fields:

```
Byte          Field
_____________________________________

0-9     "Ultra-2000 " (ASCII string)
10-26   Address range. The first value is 8 hex digits, with leading 0's,
        representing the first trace address transferred.  A hyphen only
        (no spaces) separates the first value from the second.  The second
        value, also 8 hex digits, represents the last trace address
        transferred.
27      " "   (an ASCII space character, 20 Hex)
28      File format code.  The following codes are in use:
              "B" = Binary display format
              "D" = Diagnostic format (not accessible by customers)
              "H" = Hex dump format
              "R" = Raw Data format
              "S" = Structured display format
              "X" = Xmodem
29      space
30-33   recording mode.  This is a 32-bit, bit-significant code for the
 recording mode used to obtain this trace.  The bits are :
              bit       meaning
              0-1       not used
              2         Skip data mode enabled (see bit 7)
              3         4-edge of Req/Ack enabled
              4         Phase changes before Req enabled
              5         Record on external clock enabled
              6         Filtering by ID enabled
              7         When skip data is enabled,     1 = keep 8 events
                                                       0 = keep 32 events
              8-9       not used
              10        Capture on BSY or SEL transition only
              11        Capture SCAM protocol
              12-15     not used
34-126   spaces
127     "#"
```


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After the file is transferred, a trailer character ASCII EOT (hex 04) is transmitted. This signals the end of transfer. If required by your communications package, halt the transfer and save the file on disk.

C.2 RAW DATA FORMAT

The Raw Data format is the only one that can be loaded back into the Ultra-2000 for further viewing or more analysis. The determining factor is the presence of the header record that is transmitted during upload. If this record is missing, in the wrong format, or otherwise corrupted, downloading will be aborted. Also, if a SCSI event record cannot be interpreted, downloading will be aborted.

The Raw Data file format is an encrypted format to ensure that all bytes transmitted are printable ASCII, regardless of the binary value found in the trace, while minimizing the number of bytes transmitted. The 9 bytes of each trace event are encoded into 12 bytes of printable ASCII data, using a scheme defined in section C.2.1 below. Each SCSI event (12 bytes) is followed by a line feed/carriage return combination.

A utility is available from ANCOT in C-source (IBM PC executable format) to convert the encrypted Raw Data format file to a human-readable format. Note that only the encrypted format can be reloaded into the Ultra-2000 analyzer.

C.2.1 NATURAL SCSI EVENTS

Natural events are those captured as a result of a transition on a SCSI control line. The exact recording mode is as set in the Mode Menu. See also section C.2.2 below.

Standard SCSI signal definitions apply to signals BSY, SEL, ATN, RST, MSG, C/D, I/O, REQ and ACK. Other abbreviations used below are:

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Trg	If set, the trigger condition has occurred before this event.
Ex#	Expansion port pins 1,2 and 3 map respectively to bits 0,1 and 2.
PEL,PEH	If set, the low or high byte has a parity error.

The Ultra-2000 SCSI Bus Analyzer uses a special high resolution recording method for the REQ & ACK signals. These signals show as Rq# and Ak# here. The 0 bit (Rq0) is the state at the time of capture, the 1 bit (Rq1) = 7.5 ns before capture, 2 bit (Rq2) = 15ns, 3 bit (Rq3) = 22.5ns respectively.

Bit	C15	C14	C13	C12	C11	C10	C9	C8
Signal	ATN	ATN	ATN	ATN	Trg	Ex2	Ex1	Ex0
Bit	C7	C6	C5	C4	C3	C2	C1	C0
Signal	PEH	PEL	BSY	SEL	RST	MSG	C/D	I/O
Bit	R7	R6	R5	R4	R3	R2	R1	R0
Signal	Ak3	Ak2	Ak1	Ak0	Rq3	Rq2	Rq1	Rq0

Each SCSI event consists of the following parts:

SCSI control lines	C0-C15	(2 bytes)
SCSI data lines	D0-D15	(2 bytes)
Time stamp	T0-T31	(4 bytes)
High resolution REQ/ACK info	R0-R7	(1 byte)

The time stamp is a counter of ticks since recording started; each tick is 40 ns.

The 9 bytes of the trace are encoded into 12 bytes for transmission by the following scheme:

Byte	Bits: 7	6	5	4	3	2	1	0
1	0	1	C5	C4	C3	C2	C1	C0
2	0	1	C11	C10	C9	C8	C7	C6
3	0	1	D1	D0	C15	C14	C13	C12
4	0	1	D7	D6	D5	D4	D3	D2
5	0	1	D13	D12	D11	D10	D9	D8
6	0	1	T3	T2	T1	T0	D15	D14
7	0	1	T9	T8	T7	T6	T5	T4
8	0	1	T15	T14	T13	T12	T11	T10
9	0	1	T21	T20	T19	T18	T17	T16
10	0	1	T27	T26	T25	T24	T23	T22
11	0	1	R1	R0	T31	T30	T29	T28
12	0	1	R7	R6	R5	R4	R3	R2

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Note the pattern of bits 7 and 6. The only exception to this pattern is if all of bits 0-5 are 1's; in that case bits 6 and 7 are both 0's. This results in transmitted bytes which are all in the range of 3F hex to 7E hex, which are printable ASCII values.

C.2.2 ARTIFICIAL SCSI EVENTS

In addition to the events captured as a result of transitions on the SCSI control lines, there are three types of artificial events written to the trace during recording. Each time the tracer is started by pressing **<Run>**, a **'start trace'** event is written, which has the pattern FEFF hex in the SCSI control lines word. Similarly, a **'pause in tracing'** is marked by the pattern FDFF hex, and the **'end of tracing'** has the pattern FCFF hex. For these events, the time-stamp and REQ/ACK bytes of the SCSI event will all be 0's, and the SCSI data word will contain a pattern telling the recording mode used during that tracing session. The recording mode bits are as follows:

Bit	Meaning
D0 - D1, D8 - D9, D12 - D15	Not used.
D2	If cleared, all data transfers are captured. If set, the number of data transfers captured depends on bit D7.
D3	If set, all transitions of SCSI control lines REQ and ACK are captured. If cleared, only the transition making the data lines valid is captured. See section 2.2.5.5.
D4	If set, any transition of the SCSI control lines MSG, C/D or I/O is captured. If cleared, transitions on these lines are ignored.
D5	If set, transitions on expansion port pin 1 are captured.
D6	If set, all transitions up to the Selection phase are captured. All later transitions are ignored until the next Bus Free phase, unless the data pattern during selection matches the filtering pattern.

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D7 See bit D2. If in Skip data mode, and this bit is set, capture continues until the 8th assertion of ACK in each Data-In or Data-Out phase. If cleared, capture continues until the 32nd assertion of ACK.

D10 If set, only transitions on the SCSI BSY and SEL control lines are captured. All others are ignored.

D11 Capture SCAM Protocol if set.

C.3 READABLE FORMATS

In addition to the Raw Data format, it is possible to upload in either Structured or Binary format. In these formats, the file will contain trace information just as it appears on the screen of the Ultra-2000 when displaying in these formats. These formats cannot be downloaded back into the Ultra-2000.

C.4 TRACE DUMP FORMAT

The Hex Dump format can be used to get the complete contents of the trace memory without having the problem of decrypting the transmitted data. Although the Hex Dump format requires more characters to transmit the same data as in the Raw Data format, it is less than it would be for the Structured or Binary formats. The Hex Dump format cannot be downloaded back into the Ultra-2000.

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A P P E N D I X D

THE KEYPAD AND EXTERNAL KEYBOARD FUNCTIONS

D.1 GENERAL

The table on the next page lists the keys on the keypad, their corresponding keys on the external keyboard, and their functions. The table is organized so that it scans over the keypad column by column, starting at the upper left corner and ending with the bottom right corner. Each key is listed in its basic function, followed by its 'Alt' or 'Ctrl' function if they apply. All combinations not listed are reserved or undefined.

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24-key keypad	ext.keybrd	Function
Esc	Esc	escape - cancel function
Ctrl-Esc(^Break)	BREAK	Break (Software Reset)
Quit	Q	Quit a function, or exit this menu
Alt-Quit(-)	–	'dash' or 'minus'
Alt	Alt	select Alternate function
Ctrl	Ctrl	select Control function
Run	R	RUN - start tracing
Alt-Run(C)	C	C hex
Stop	S	STOP - stop tracing
Alt-Stop(8)	8	8 hex
Display	D	Display
Alt-Display(4)	4	4 hex
Ctrl-Display	Ctrl-D	delete Data Patt byte in Search Pattern
No	N	No
Alt-No(0)	0 (zero)	0 hex
Pause	P	Pause tracing
Alt-Pause(D)	D	D hex (Note: same as <Display>)
Flip	F	flip (toggle) between display formats
Alt-Flip(9)	9	9 hex
Ctrl-Flip(^Find)	Ctrl-F	Find certain command/phase/.. in the trace
Next	<space>	display Next page of trace
Alt-Next(5)	5	5 hex
Ctrl-Next(^FNxt)	Ctrl-L	Find next occurrence
Yes	Y	yes
Alt-Yes(1)	1	1 hex
◂	◂	move cursor left (non-destructive)
Alt-◂(E)	E	E hex
Trig	T	display the trigger selection menu
Alt-Trig(A)	A	A hex
Ctrl-Trig(^Time)	Ctrl-T	calculate time differential between trace event
Prev	–	display Previous page (approximately) of trac (Note: same as <Alt-Quit>)
Alt-Prev(6)	6	6 hex
Ctrl-Prev	Ctrl-K	Find-Previous occurrence
X	X	don't care
Alt-X(2)	2	2 hex
Ctrl-X(^Print)	Ctrl-P	toggle printing to external printer
▸	▸	move cursor right (non-destructive)
Alt-▸(F)	F	F hex (Note: same as <Find>)
Mode	M	display the mode-of-recording selection menu
Alt-Mode(B)	B	B hex
Alph-Hx	H	toggle between alpha and hex format in data phase
Alt-AlphHx(7)	7	7 hex
Ctrl-AlphHx(^TmF)	E	toggle differential & elapsed time-stamp format
Util	U	display Utilities menu (Note: same as <Alt-< >)
Alt-Util(3)	3	3 hex
▴	▴	move cursor up
Alt-▴(HM)	Home	Home
Ctrl-▴(PgUp)	Pg-Up	Page Up
▾	▾	move cursor down
Alt-▾(END)	End	End
Ctrl-▾(^PgDn)	Pg-Dn	Page Down
16/8	W	toggle NARROW and WIDE data display
Alt-16/8(BS)	BackSpace	Back Space
Ctrl-16/8(^BinF)	L	toggle binary display formats
Enter	Enter	ENTER selection

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A P P E N D I X E

THE SCAM PROTOCOL

E.1 GENERAL

The "SCSI Configured automatically (SCAM) protocol is a new addition to the SCSI-3 parallel standard, which enables assignment of SCSI IDs to individual devices automatically and totally under software control. The SCAM protocol has been designed to tolerate and to allow coexistence of legacy devices with hardwired IDs (jumpers) and the new SCAM-capable devices on the same SCSI cable.

We refer the reader to the SCSI-3 specification (document: SCSI-3 Parallel Interface 'SPI', Annex B) for detailed description of the protocol. In this document, we will only outline the concepts of SCAM.

The SCAM protocol is defined in two levels (two versions):

1. Level-1 SCAM master devices use hard IDs. Only a single level-1 SCAM master is allowed on the bus. The SCAM slave devices must power up before or at the same time with the master. This level protocol can be implemented using most of the currently available SCSI controller chips.

2. Level-2 SCAM master devices may use hard or soft IDs. There may be multiple level-2 SCAM masters on the bus. The SCAM masters and slaves may power up independently. This level protocol may require a new generation of SCSI controller chips.

The SCAM ID assignment sequence executes as the first thing after power up, or after SCSI reset. The sequence is as follows:

First, the SCAM master (the host adapter) scans the bus for hardwired IDs (the legacy devices), and builds a table of IDs already assigned. The SCAM devices are designed to ignore these short-duration selections.

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Second, the SCAM master assigns the soft IDs to the SCAM capable devices. This is done using a modified Selection phase, with the MSG line asserted by the master, and with no data bits being driven on the data bus. The BSY and SEL stay asserted to hold off the legacy devices. All SCAM devices now "wake up" and participate in the protocol. The devices drive certain control lines (C/D and I/O); they execute certain sequences on the D5, D6, and D7 lines, and use the lower five data bits for transferring information about ID which they (the slaves) prefer. The slaves then receive ID confirmation from the SCAM master via these low order bits. The SCAM protocol will assign IDs 0 through 7 on a Narrow bus, and IDs 0 through F hex on a Wide bus. The soft IDs come from the pool of IDs available following the hard ID scan.

The SCAM protocol executes during the boot process. This may take a few seconds, depending on how many devices are on the bus.

SPECIAL SITUATIONS:

What if there is no SCAM host adapter? Does that imply that all SCAM devices will respond slowly to Selection? "No". Each SCAM device is shipped with a preferred ID number. For example, external disk drives will ask for ID 6.

Can there be more than one SCAM host adapter on the bus? "Yes, but" there is a SCAM function code which initiates a "dominant master contention" protocol. The first host adapter to win an Isolation becomes the master for that SCAM protocol sequence. All others become slaves.

What if you have a non-SCAM master and several devices with the same preferred ID? In that case, the bus will have the same problems as SCSI-2 today, when multiple devices want the same ID. This is solved the same way, with jumpers on the devices to select a unique ID. SCAM doesn't magically make old devices work, but it doesn't make them any worse either.

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E.2 USING THE Ultra-2000 SCSI BUS ANALYZER FOR SCAM

E.2.1 ACTIVATING THE SCAM DISPLAY

- Go to the Mode menu by pressing **<Mode>** from either the main menu or from a trace display

- Select item **<6>** - Capture SCAM Protocol so that an 'E' (for 'enabled') appears in the square brackets. This will also turn ON capture of the Phase Changes (item 2). Both of these must be ON for SCAM tracing.

- Start tracing by pressing **<RUN>** from any of the normal places. The SCAM Protocol will be captured automatically when it occurs.

See section 3. for display of SCAM trace in structured and binary display format.

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A P P E N D I X F

SAVE/RESTORE TRACE DATA TO/FROM PC HOST

F.1 VIA PARALLEL PORT

NOTE: In this section, reference to the Ultra-2000 applies as well to the Ultra-2000 portable and the Ultra-2000/Lite.

PROGRAM NAME

ANCOTPAR.EXE is the file name of the program executing on the PC host.

REQUIREMENTS

- A bi-directional parallel port conforming to the Enhanced Parallel Port (EPP) standard, configured as LPT1 (using IRQ7) or LPT2 (using IRQ5).
- An MS-DOS operating system environment executing on a minimum of a 286 CPU.
- A special purpose, vendor supplied, parallel interconnect cable.

OPERATION:

The program operates in two modes: DOWNLOAD, when sending a data file to the Ultra-2000, and UPLOAD, when receiving data from the Ultra-2000 and capturing it in a file.

In Download mode, the operator must first configure the Ultra-2000 to receive the data, and then start the utility ANCOTPAR.EXE on the PC host, with the appropriate filename.

Type:

ancotpar -D trace.001 **<Enter>**

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The data transfer then starts and proceeds automatically until the end of the file is reached. In Upload mode, the program operates as a Terminate-Stay-Resident (TSR) program so that it can be used in conjunction with a terminal emulator program to control the Ultra-2000 over the serial link. The operator starts the utility with the appropriate command line option and optional path name and initial filename. The operator can then start the terminal emulator to control the Ultra-2000 directly. Several upload trace data files can be captured in one session starting with the specified optional filename or a default filename. The operator can then exit and suspend the TSR to free up the memory.

COMMAND LINE OPTIONS

If the utility is evoked without any options or filename, a simple Help screen, describing the options, will be displayed. If options are entered they must precede the optional; directory path and/or filename. Available options are as follows:

- D - program executes in DOWNLOAD mode to transmit the specified file to the Ultra-2000.
- U - program executes in UPLOAD mode to receive trace data and capture it into one or more files.
- L2 - select LPT2 as the parallel port for data transfer. The program default is LPT1. L1 can be entered if desired.
- Q - suspend the program currently executing in UPLOAD mode as a TSR, in order to free up the memory.
- T - required when using a Toshiba laptop computer, which utilize a slightly different parallel port format.

FILE NAME GENERATION

Under MS-DOS, all filenames are composed of a base name of up to 8 characters, followed by an optional 3 character extension. This is generally referred to as the "8 dot 3" format. In Upload mode, the utility reserves the extent name for a 3-digit series number. If the operator should

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enter an extent name that is non-numeric, it will be replaced with the number "001" or the next available number.
For example:

If the filename is specified as "TEMP.TXT", the first file will have the name "TEMP.001" and the second file will be "TEMP.002", etc.

If the operator enters a filename with a numeric extension, the first file generated will use that number, or the next available number. For example:

If the filename is specified as "TEMP.055", the first file captured will be "TEMP.005" unless that filename already exists. Otherwise, the first file will be "TEMP.056" or the next available number.

Remember that trace data in "raw format" can only be downloaded (restored) back to the Ultra-2000.

Also note that the downloaded trace is placed in the Ultra-2000 trace memory starting always from location zero. Therefore consecutive uploads automatically overlay the previous traces. In other words, only a single uploaded trace can be examined at a time.

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A P P E N D I X G

EXAMPLE OF USING THE PC & PROCOMM

FOR SAVING/RESTORING THE TRACE VIA SERIAL PORT

There are several communications programs which could be used for the remote control or up/downloading of programs or traces from/to the Ultra-2000 analyzer. In this Appendix, we will describe using the PROCOMM PLUS program, as an example.

G.1 SETTING UP PROCOMM OPTIONS

First of all, we assume that your copy of the PROCOMM PLUS has been installed properly.

Start the program by typing **PCPLUS** followed by the **<Enter>** key, and the initial screen will be displayed. Then press any key to enter the terminal emulation mode. There is a good chance that the interface (of PROCOMM) is set up the way you need it, and that PROCOMM displays a good screen.

If you need to change the baud rate of PROCOMM to match that of the Ultra-2000, enter **<Alt-P>** and choose the correct settings.

However, if the setup of PROCOMM is wrong, almost any kind of erratic behavior can be expected. To correct it, type **<Alt-S>** and you will enter the PROCOMM SETUP so that you can select correct options. The following menu will be displayed:

```
  MODEM OPTIONS
▸ TERMINAL OPTIONS
▸ DISPLAY/SOUND OPTIONS
▸ GENERAL OPTIONS
  HOST MODE OPTIONS
▸ FILE/PATH OPTIONS
  COLOR OPTIONS
```


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```
      ▸  PROTOCOL OPTIONS
         EDITOR OPTIONS
         SAVE SETUP OPTIONS
```

You need to edit only the few selections marked by '▸' above.

A. TERMINAL OPTIONS:

```
      A - Terminal emulation        VT-100
      B - Duplex                    FULL
      C - Soft flow ctrl (XON/XOFF) ON
      D - Hard flow ctrl (RTS/CTS)  OFF
      E - Line wrap                 ON  (Don't Care)
      F - Screen scroll             ON  (Don't Care)
      G - CR translation            CR
      H - BS translation            NON-DESTRUCTIVE
      I - Break length (millisecs)  350 (Don't Care)
      J - Enquiry (ENQ)             OFF (Don't Care)
      K - EGA/VGA true underline    OFF (Don't Care)
      L - Terminal width            80  (Don't Care)
      M - ANSI 7 or 8 bit commands  8 BIT
```

B. DISPLAY/SOUND OPTIONS

In this options menu, all selections are "Don't Care", except the 'F'. Set it as follows:

```
      F - Status line               OFF
```

C. GENERAL OPTIONS

In this options menu, all selections are "Don't Care", except the 'B'. Set it as follows:

```
      B - CD high at exit           IGNORE
```

D. FILE/PATH OPTIONS

We recommend that you check the selected download path. The default path for the downloaded file is:

```
      C:\PCPLUS\DOWNLOAD
```


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You should change it to whichever directory you prefer to use.

E. PROTOCOL OPTIONS

When selected, the following sub-menu will be displayed first:

```
  GENERAL OPTIONS
▸ ASCII PROTOCOL OPTIONS
  KERMIT PROTOCOL OPTIONS
  ZMODEM PROTOCOL OPTIONS
  EXTERNAL PROTOCOL OPTIONS
```

Select ASCII PROTOCOL OPTIONS and the following detailed selection sub-menu will be displayed. All selections here are "Don't Care", except the ones listed below.
Set them as follows:

```
D - Character pacing (millisec)  0
E - Line spacing (1/10)          0
G - Strip 8th bit                NO
I - CR translation (upload)      NONE
J - LF translation (upload)      NONE
K - CR translation (download)    NONE
L - LF translation (download)    NONE
```

When finished with all these selections, press **<Esc>** three times and save changes when prompted, or when the PROCOMM returns back to the terminal emulation screen.

The next two sections describe how to execute the SAVE TRACE TO HOST (upload) and RESTORE TRACE FROM HOST (download) functions using the PROCOMM program. It is assumed that you correctly connected together the serial ports of the Ultra-2000 and the PC. Use the serial (NULL MODEM) cable supplied by ANCOT (see pinout in appendix A.4) and connect the SERIAL-1 connector (DB-9) on the Ultra-2000 to the COM port on the PC.

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G.2 SAVE TRACE TO HOST VIA SERIAL PORT

G.2.1 ASCII TRANSFER

ON THE PC:

- start PROCOMM PLUS as described in setup, and enter the terminal emulation mode.
- press **<PgDown>** to activate the upload function.
- select **<A>** for ASCII format from the intermediate menu (all Ultra-2000 data formats are printable ASCII as transferred on the line).
- as a response to the prompt, type the filename where you want to save the trace.
- at this point, hold off pressing the **<Enter>** until the Ultra-2000 is ready.

ON THE Ultra-2000:

Starting from the main menu

- press **<3>** for 'Save/Restore the trace',
- press **<0>** for 'save trace to host via serial port',
- press **<0>** for 'raw trace data format'. You can select any other format, but remember that only the raw data format can be restored.
- select the starting and ending addresses to define section of the trace to be saved (default would be the full size used)
- at this point, **hold off confirming** the transfer (i.e. do NOT press **<Yes>** !!) until the PC is ready.

ON THE PC:

- press **<Enter>** to start the upload function.

ON THE Ultra-2000:

- press **<Yes>** to see the address counter on the Ultra-2000 counting and the data being listed on the PC. When the transfer is finished, message **"- finished -"** will be displayed on the Ultra-2000 screen, and there will be the EOT character (♦) displayed after the last data line on the PC.

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You can need to press **<Esc>** on the PC to stop the transfer and save the file.
The trace is now saved on the PC in the designated file.
You can exit PROCOM PLUS by typing **<Alt-X>** on the PC.
You can return to the main menu on the Ultra-2000 by typing **<Esc>**.

G.2.2 XMODEM TRANSFER

ON THE PC:

- start PROCOMM PLUS (as described in setup) and enter the terminal emulation mode.
- press **<PgDown>** to activate the upload function.
- select **<X>** for XMODEM
- as a response to the prompt, type the filename where you want to save the trace.
- at this point, PROCOMM will display a progress box and wait for the transfer to begin.

ON THE Ultra-2000:

Starting from the main menu

- press **<3>** for 'Save/Restore the trace'
- press **<1>** for saving the trace by XMODEM transfer
- select the starting and ending addresses to define the section of the trace to be saved (the default is the full trace)
- at this point, the XMODEM transfer should start.

You will see the address counter on the Ultra-2000 counting, and the progress box in PROCOMM will be counting. When the transfer is finished, you can exit PROCOMM by typing **<Alt-X>** on the PC. You can return to the main menu on the Ultra-2000 by typing **<Esc>.**

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G.3 RESTORE TRACE FROM HOST VIA SERIAL PORT

G.3.1 ASCII TRANSFER

ON THE PC:

- start PROCOMM PLUS and enter the terminal emulation mode
- press **<PgUp>** to activate the download function
- select **<A>** for ASCII format from the intermediate menu (all Ultra-2000 data formats are in ASCII as transferred on the line)
- in response to the prompt, type in the filename where the previously saved trace was stored
- at this point, **hold off pressing <Enter>** until the Ultra-2000 is ready.

ON THE Ultra-2000:

From the main menu on the Ultra-2000:

- press **<3>** for 'Save/Restore the trace',
- press **<3>** for 'restore trace from host via serial port',
- press **<Y>** to confirm the start of transfer.

ON THE PC:

- press **<Enter>** on the PC to start the restore operation.

ON THE Ultra-2000:

The address counter on the Ultra-2000 will count as the data is being transferred. When finished, the Ultra-2000 clears the screen and returns to the main menu.

The trace has now been restored to the Ultra-2000 trace memory and can be displayed using the **<D>** display function.

You can exit PROCOM PLUS by typing **<Alt-X>** on the PC.

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G.3.2 XMODEM TRANSFER

ON THE Ultra-2000:

Starting for the main menu

- press **<3>** for 'Save/Restore the trace'
- press **<5>** for restoring the trace by XMODEM transfer
- at this point, the Ultra-2000 is waiting for the transfer to begin.

ON THE PC:

- start PROCOMM PLUS (as described in setup) and enter the terminal emulation mode
- press **<PgUp>** to actcivate the download function
- select **<X>** for XMODEM
- as a response to the prompt, type the filename where the previously saved trace was stored
- at this point the transfer should start and PROCOMM will display a progress box.

You will see the address counter on the Ultra-2000 counting, and the progress box in PROCOMM will be counting. When the transfer is finished, you can exit PROCOMM by typing **<Alt-X>** on the PC. You can return to the main menu on the Ultra-2000 by typing **<Esc>**.

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A P P E N D I X H

SCSI FACTS & TIPS

H.1 GENERAL

The Importance of proper cabling and termination in SCSI systems can never be emphasized enough. Poor cabling or termination often results in erratic operation, or may cause the system not to operate at all. Erratic operation is the worst; the less often errors occur, the more difficult it is to diagnose their source. Speed of transmission over the bus is also an important factor in determining whether the marginal connection causes errors. Many existing devices on the market today transfer the data at rates under 1 MHz; the SCSI-2 specifies a FAST mode at 10 MHz with tighter timing tolerances. The SCSI-3 FAST/20 mode uses even tighter timing and tolerances. Devices of various speeds can be connected to the same bus, and you may find that only the faster devices cause transmission errors.

H.2 CABLING

We recommend using good quality cables. Always use cable with twisted pairs, whether the flat or the round type. As a rule, do not use the non-twisted type for external connections. Its sensitivity to electrical noise and crosstalk often results in low signal quality and low electrical margin, causing troubles not worth the small financial savings. To ensure good quality, buy cables from a reputable vendor.

H.3 ELECTRICAL CONNECTION & TERMINATION ON THE SCSI BUS

There are three alternatives: the Single-Ended, HVD (High Voltage Differential), and LVD (Low Voltage Differential) interfaces. These alternatives are mutually exclusive, and can not be mixed

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on the same SCSI bus system; all devices and both terminators on the same SCSI bus must use the same kind of interface. All signals should be terminated at both ends of the cable.

FAST SCSI (over 5 MHz), including FAST/20, should not use the single-ended alternative. THE FAST/40 ('Ultra-2') should use LVD only.

The SCSI cable is used as a transmission line, and its termination is very important. According to the SCSI specifications, as well as to good engineering practice, the SCSI cable should be terminated on both physical ends. If more devices are connected to the same cable, then only the last ones, as positioned on the SCSI cable, should have the terminators. Exactly two terminators should be used.

Termination is straightforward when using a SCSI adapter in the host computer connected to a single disk drive. In such case, terminators have to be installed in both the SCSI Host Bus Adapter (HBA) and the disk. This is often the case when peripherals are built into the system, such as an internal disk drive.

It becomes more complicated if the same SCSI bus is connected to internal devices and also to external devices, such as an external CD-ROM drive or a backup tape drive. In such cases, you have to determine what are the physical ends of the cable, and place terminators in those devices. Terminators in all other devices should be removed. In systems with the internal cable brought out to the back panel, where you would only occasionally be attaching external peripherals, it may be practical to use one terminator permanently installed in the SCSI adapter inside the chassis, and to use a removable external 'plug-in' terminator in the external SCSI connector on the back panel of the host chassis. This external terminator can then be removed when attaching an additional external SCSI peripheral (e.g., tape for back-up), and inserted in the second daisy chained SCSI connector on the external peripheral.

H.3.1 SINGLE-ENDED ALTERNATIVE

This alternative uses transfer over a single "live" line in reference to GROUND. "True" signal is defined as a low level (0 to .8 V), and "False" signal is defined as a high level (2.0 to 5.25 V).

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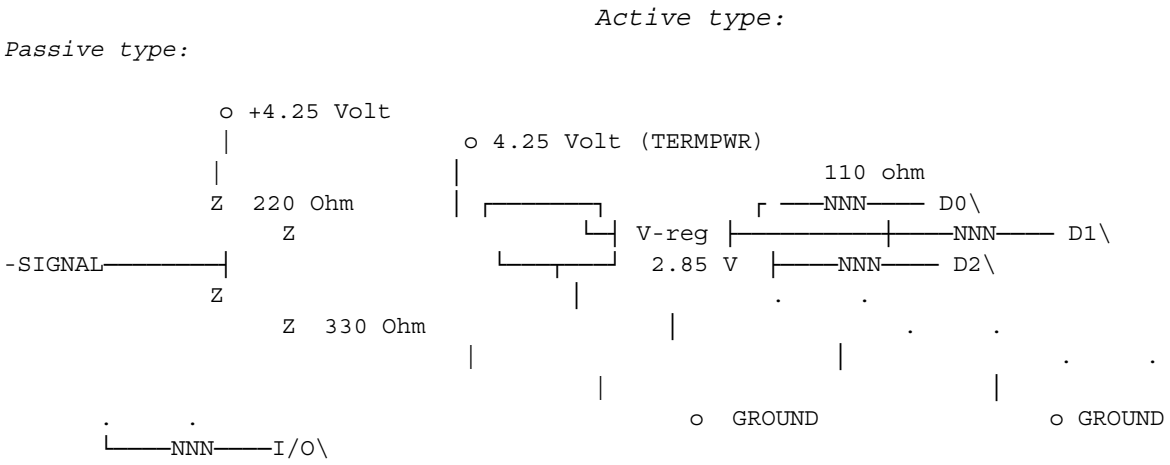
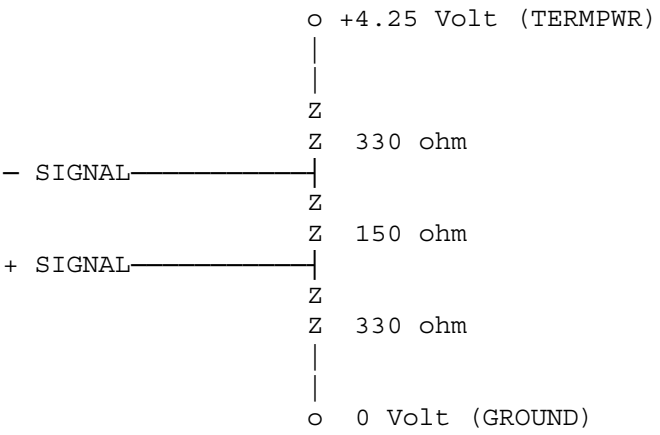
SINGLE-ENDED TERMINATION:



H.3.2 HVD - HIGH VOLTAGE DIFFERENTIAL ALTERNATIVE

This alternative uses transfers over two electrically symmetrical lines denoted +SIGNAL and -SIGNAL. The "True" signal is defined as +SIGNAL more positive than -SIGNAL, and the "False" signal is defined as +SIGNAL more negative than -SIGNAL.

Differential termination:



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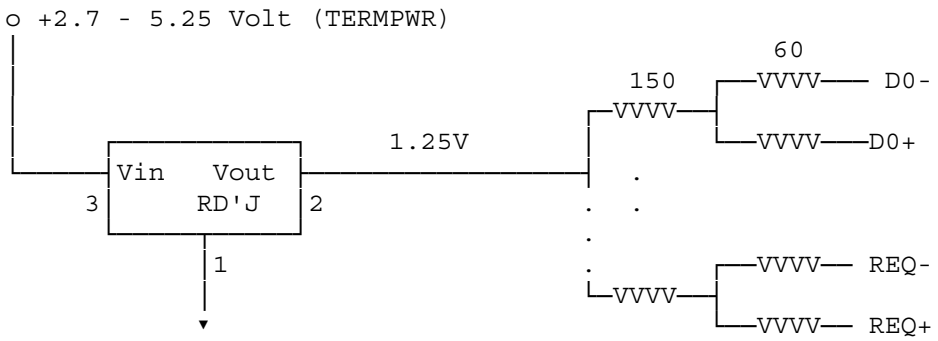
The Differential interface is electrically more robust, therefore there was no need to develop a more expensive active type terminator.

H.3.3 LVD - LOW VOLTAGE DIFFERENTIAL ALTERNATIVE

This alternative uses transfers over two electrically symmetrical lines denoted +SIGNAL and -SIGNAL. "True" signal is defined as +SIGNAL more positive than -SIGNAL, the "False" signal is defined as +SIGNAL more negative than -SIGNAL.

LVD termination: (active type)



NOTE & WARNING:

It is important to remember that the terminator must match the interface type: single-ended interfaces must use single-ended terminators; differential interfaces must use differential terminators. In case of single-ended terminators, there are two types available: 'passive' and 'active'. The 'active' type SE terminator is electrically better since it provides higher noise immunity. It is permissible to mix the two S-E terminator types: you can use the 'passive' type on one end of the SCSI cable, and the 'active' type on the other end of the same cable.

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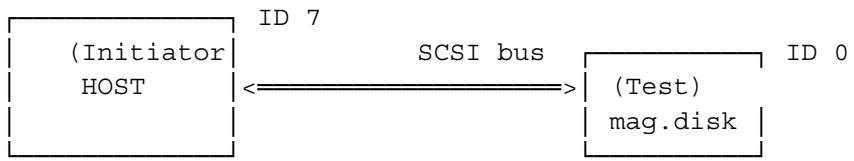
H.4 THE TERMINATOR POWER ('TERMPWR'):

The terminators are often implemented as SIP resistors (the 'passive' type) which are inserted in a socket near the SCSI connector on the device itself, or on the SCSI adapter. Sometimes the terminators are in the form of external "through-connector" type plug-ins. The SCSI devices often provide the power ('TERMPWR') for their own terminators internally; however, do not rely on that. The TERMPWR (pin 26 on the 50-pin SCSI cable) is specified to be at least 4.0 volts (SCSI-1 spec), or 4.25 volts (the newer SCSI-2 spec). Experiments show that the higher the TERMPWR (up to 5.25 volts maximum), the better the noise immunity. Also, it is not sufficient to measure TERMPWR level at the source. Sometimes a device does not provide its own TERMPWR, and uses it from the SCSI cable. There may be no problems if the cable is short. However, if the cable is long, then you have to consider the voltage drop across the full length of the cable. You may discover that the TERMPWR at the terminator, where it is finally used, is lower than the specified limit.

H.5 SCSI INITIATORS & TARGETS

There are two kinds of devices on the SCSI bus: the SCSI Initiators start the communication, and the Targets respond. The Initiators are devices that request commands to be carried out. Targets are devices that carry out commands. SCSI host adapters are Initiators, but at times, the host adapter may need to act as a Target for some commands. SCSI peripheral devices are Targets, but for some commands e.g., a COPY command, the peripheral may need to act as an Initiator temporarily. The single-byte SCSI bus (SCSI-1 or SCSI-2 'Narrow') supports up to eight devices, in any mix of Initiators and Targets, with the limitation that at least one Initiator and at least one Target are present. The SCSI-2 'Wide' bus supports up to 16 devices.



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A SCSI system may be as simple as a single computer with SCSI host adapter connected by cable to a single SCSI Target device, such as a disk drive.

H.6 SCSI DEVICE ADDRESSING

Each device on a SCSI cable must use its own ID# address. The SCSI ID# (initiator or target address) of each SCSI device connected must be selected by setting the proper jumpers or switches on the SCSI device itself. Each ID# must be unique; duplicate addresses may hang the whole SCSI bus, or may result in unpredictable behavior. This latter case may be difficult to identify.

You may not need to be concerned about SCSI IDs on working systems. However, as a rule, always verify SCSI ID# selections when adding a new device to an existing SCSI system. Most SCSI peripherals are shipped from the factory with SCSI ID# set to 0.

Some of the newest SCSI devices (starting in 1994) have their SCSI IDs assigned automatically without the need for mechanical jumpers. This method is defined in the SCSI-3 SCAM protocol standard document. A brief description of SCAM is in Appendix E.

H.7 SCSI DATA PARITY

The data path on the SCSI bus consists of 8 data lines and 1 parity line (on the 'Narrow' bus). SCSI-1 specified parity as an option, however in SCSI-2 it became mandatory. You can expect that practically all systems in operation today support parity. The only catch may be that on some devices of the SCSI-1 variety, parity could be disconnected and has to be enabled by a jumper. On some systems parity error, if detected, will be reported, but the system remains operational; on other systems, parity errors will cripple its operation.

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H.8 MIXING SE & DIFF SCSI DEVICES

The single-ended and differential interfaces are mutually exclusive. The SCSI bus must use either all single-ended, or all differential components. In situations when you need to connect single-ended and differential devices together on the same SCSI bus, you must use a SE to Diff Converter, such as the ANCOT model SED-608 for the 'Narrow' bus, or model SED-616 for the 2-byte 'Wide' bus. Many of the newer SCSI peripherals use the differential interface.

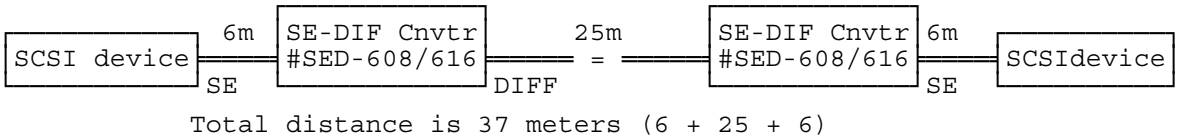
H.9 SCSI CABLE LENGTH

The maximum cable lengths recommended by the SCSI specification are 6 meters for the single-ended bus, and 25 meters for the differential bus. These lengths are recommended for configurations where you need to achieve the maximum specified performance. However, in many situations where longer lengths are required, maximum performance is not the issue. Remember that you can extend the cable length significantly, especially in low noise environments, or if slower transfer rates are used and all design standards are respected.

H.10 EXTENDING THE SCSI CABLE

The total length of the cable, for maximum performance at the maximum transfer rates of 5 MHz as recommended by the SCSI specification, is 6 meters for single-ended or 25 meters for differential configurations. It is possible to extend this length considerably by using single-ended to differential converters. Several schemes are possible, depending on how much distance is needed and which interface is used on the SCSI devices. See the following examples.

Example 1:



Total distance is 37 meters (6 + 25 + 6)

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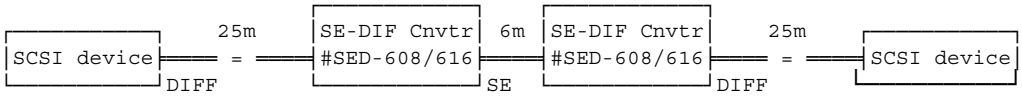
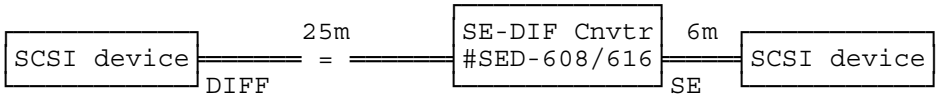
Example 2:



Total distance is 56 meters (25 + 6 + 25)

Example 3:



Total distance is 31 meters (25 + 6)

The SED-608/616 Converter does not occupy any SCSI ID, and is functionally transparent to the SCSI devices connected. It is possible to use more than two converters in series and thus achieve even longer distance.

The Converters are available from ANCOT for the 'Narrow' bus (SED-608) and for the 'Wide' bus (SED-616). Both models support asynchronous, synchronous, and SCSI-2 Fast modes.

WARNING! It is very important that you use good quality cables in these 'maximum systems'. The deficiencies in the cable (crosstalk, capacitance, skew, etc.) will accumulate over the long length, and may exceed its allowable value.

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